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ABSTRACT

Through questionnaires, observations, and interviews, this study revealed the degree to which 31 high school teachers altered their classroom spaces and/or adjusted their routines to meet their pedagogical goals at a temporary school site. Teachers emphatically desired: (1) an appropriate amount of space to rearrange student furniture, enabling them better interaction with students for planned activities; (2) an ability to control the location and amount of lighting during those activities; and (3) access to adequate computing tools for their students. The ability to control noise, temperature, and ventilation was also important. Teachers' mediation of classroom spaces appeared to be closely associated with individual teaching goals rather than physiological responses to the environment, although there was evidence of the importance of accommodating teachers' perceptions of their own physical wellbeing. The study also disclosed a noticeable social-cultural need for meeting places within the school for teacher peer interactions and equally negative responses to sharing teaching spaces with those with dissimilar tastes and goal aspirations. Four appendixes include consent forms and approval letters; questionnaire, observation form, and interview questions; data results; and classroom physical measurements. (Contains 70 references.) (Author/SM)

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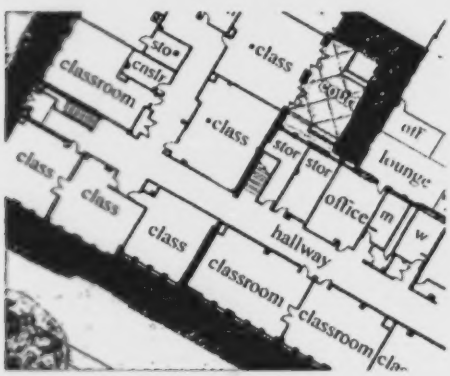
How Teachers Alter Their Space and/or Routines because of Classroom Character



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Chair of Supervisory Committee:

_____

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Reading Committee:

_____

Jerry Bamburg

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Abstract

TEACHER INTERACTIONS WITHIN THE PHYSICAL ENVIRONMENT:
How Teachers Alter Their Space and/or
Routines because of Classroom Character

Dale Christopher Lang

Chairperson of the Supervisor Committee:
Associate Professor Margaret Plecki
Educational Leadership and Policy Studies, College of Education

Through questionnaires, observations and interviews, this study revealed the degree to which 31 high school teachers altered their classroom spaces and/or adjusted their routines to meet their pedagogical goals at a temporary school site. If conventional wisdom suggests that teachers' actions within their designed physical environments (DPE) affect student achievement, then it appears that their perceptions and alterations of their classroom spaces are important to consider. Evidence suggests that an appropriate awareness of the effects of the physical environment coupled with a clear definition of teacher project goals through a deeper collaboration with teachers, architects and facility planners will reveal more meaningful building design criteria.

Teachers in this study emphatically desired: 1.) an appropriate amount of space to rearrange student furniture enabling them better interaction with students for planned activities, 2.) an ability to control the location and amount of lighting during those activities and 3.) access to adequate computing tools for their students. The ability to control noise, temperature and ventilation was also important to consider. Teachers' mediation of classroom spaces appeared to be closely associated with individual teaching goals rather than physiological responses to the environment although there was evidence of the importance of accommodating teachers' perceptions of their own physical well-being. This study also disclosed a noticeable social-cultural need for meeting places within the school for teacher peer interactions and equally negative responses to sharing teaching spaces with those with dissimilar tastes and goal aspirations. The significance of this study lies in its contribution to the knowledge base concerning teacher mediations within their classroom spaces.

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DEDICATION

I dedicate this dissertation effort to Julie Josette my loving wife, who allowed me to pursue my desire to better understand teachers' motivations within their work places. Julie encouraged me to apply to and attend a wonderful graduate school that resulted in the rearrangement of our lives over the past eight years. We left family, friends and successful careers behind so that I could discover evidence that may better inform those who plan and design educational facilities.

Julie, I hope this experience was worth it and I will always love and appreciate your unselfish support of my dreams. It is your turn now.

CHAPTER 1 - INTRODUCTION

Purpose and Organization of the Study

This dissertation is a written record and analysis of an "exploratory" case study involving 31 secondary teachers at an interim school site. Its purpose was to determine how teachers mediate their physical environment and/or change their work plans because of the character of their classroom spaces. It is hoped that information gained from this study may better inform administrators and designers of what is critical to teachers when planning new or remodeled schools. Six measures: 1. Size & Layout, 2. Light & Glare, 3. Noise & Acoustics, 4. Temperature & Ventilation, 5. Finishes & Furnishings and 6. Tools & Communication were developed in earlier investigations and used in this study to examine teacher perceptions of their "designed physical environments" (DPE) or classroom spaces.

The study is divided and organized into five chapters. Chapter One includes the organization, a general background and purpose of the study, school site and subject characteristics, descriptions of the six protocol measures used, significance of the study and four research questions. Chapter Two includes a review of the relevant literature and Chapter Three details the study's methodology. Chapter Four contains the presentation of the collected data, an analysis and teacher priorities, and Chapter Five includes a discussion of the results of this study through a review of the original research questions followed by a discussion of a reconceptualization of the original theoretical basis. Two research questions were revised within a new theoretical framework and results were reevaluated and discussed. This is followed by the study's conclusions of what is relevant to teachers in their classrooms and final recommendations are made to administrators, planners and those who wish to extend this line of research in the future.

General Background

Public school buildings are constructed in a variety of sizes, shapes and styles depending on their location, budget, specific purpose and style-era of construction. Classrooms or the physical spaces within these building designed for the specific purpose

of teaching and learning may also be unique but often these spaces are similar in design and appearance with one another. This similarity may be attributed to a uniformity of "American high schools' purposes, structures and procedures..." (Sizer, 1985) or perhaps their commonality is the result of years of 'evolutionary' refinement (Haskins, 1990). Regardless of the cause for current classroom configurations, billions of dollars each year are needed and expended to repair and improve school facilities (Federal General Accounting Office Report, 1995).

The architecture of school interiors or *designed physical environments* (DPE) within which formal instruction occurs plays an important role in student learning when physical properties are considered and individual factors are controlled under particular circumstances (McGuffey, 1982). Evidence from many environmental psychology studies (elaborated upon in Chapter 2) involving behavioral responses to DPE also support the notion that these places may have positive or adverse effects upon users when their responses are measured in limited or controlled ways (Heft, 1997).

Some buildings have an "explicit function" to divide people into categories and their disposition in space represents a particular field of social practice or knowledge. The separation of children or students into classes according to their abilities, age or subject matter is evidence of a philosophy based on cultural standards. Human perception of building space may be described in spoken or written texts which carries its own social or cultural meaning (Markus, 1987), or through spaces described as personal experiences (Piaget, 1954/1971) and/or feelings and emotions (Norberg-Shulz, 1965).

Buildings may be also be considered objects as well as a places. Therefore architecture in general, and schools in particular, may be thought of as cultural and social 'objects' that have meaning beyond their physical characteristics. Architecture as a "... cultural object is thus on a 'higher level' than a physical one" (p. 30, Christian Norberg-Shulz, 1965)

It is apparent from the previous studies that some relationship exists between the perceived character and quality of the DPE and the performance of the individuals who perform within these spaces. The nature of the American public educational process

however, makes it difficult to accurately control many subtle variables including but not limited to the local school culture, continually changing student group dynamics, on going curriculum transformation, various pedagogical styles, schedule or time constraints and parent pressure for student progress.

By limiting this study to a discrete number of secondary teachers (31) on one school site toward the end of the school term, it was felt that the local school culture, individual classroom dynamics and district wide curriculum programs were well established for that school year. Teachers by this time of the year had established regular routines to deal with most common variables in their day-to-day involvement with students. They had mitigated most major spatial concerns or had at least thought about their DPE as it related to their teaching.

School Site and Subject Characteristics

At the time of the study, the subject teachers were relocated to an interim site (see Figure 1) while their permanent school site (see Figure 2) was undergoing major changes and renovations. Because of this upheaval in daily teacher routines, it seems likely that many of the subjects were familiar with and more conscious of their present DPE if only in comparison to their old classrooms.

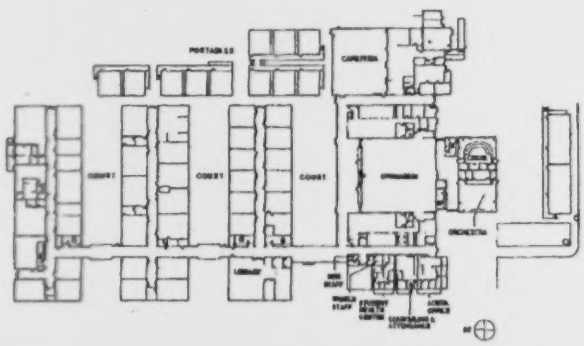

FIGURE 1. Interim school plan layout

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Aside from the daily evidence before the teachers of the changes to their classrooms from the previous year, they were continually updated at monthly staff meetings as to the changes they could expect to their future DPE back at the original school site. Some teachers at this school were comfortable with pending changes regarding the sharing of future classrooms but for various reasons that will be discussed within this study, many were not.

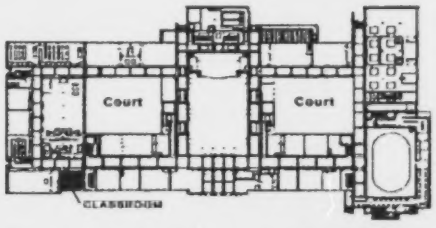

FIGURE 2. Original historic building plan layout

Because teachers in this study had been uprooted from their rooms at the previous site, forced to rethink their present DPE layouts and were continually informed of their future arrangements, it was felt that data gathered and their participation in this study was more topical then if the investigation had been at a school site with teachers who were more settled in their classrooms.

The interim school site in which this study took place was originally a junior high (7th and 8th grades) school, built in the late 60s. In architectural terms, the plan layout is labeled a "finger plan" arrangement (see Figure 3) with individual wings or "fingers" of double classroom rows, separated by a common corridor. These parallel wings allow each classroom space ample daylight and air if windows are operable. The fingers or wings are oriented east and west so that the classrooms or DPE, each with an equal amount of continuous glazing, receive either southern or northern exposure to daylight.

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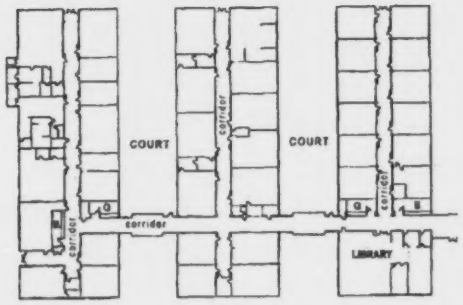

FIGURE 3. Enlargement of "finger plan" showing classroom rows

Most of the added portable classrooms were on the east side of the school in two north-south parallel rows with eastern sunlight exposure. The building was single story and was consequently distributed over a wide area. Administration, student and health services, teacher's lounge and gymnasium were at the southern end of the site. The library was located towards the center of the west side of the school.

This study involved a questionnaire, individual observations and interviews of 31 regular, substitute and intern secondary teachers out of a total staff of 52. Most of the subjects 81%, were teachers at the original school site. The study also occurred during the first year that subjects were at the interim site; therefore, all of the teachers who took part were reacting to a "new" or changed DPE from their previous school year.

A pilot study that helped to develop the measures and instrumentation for this study was conducted two years earlier at the original historic school site. The investigator was also part of a design team that helped organize and layout the new, renovated school site. There was no communication with the subjects of this study that was pertinent to the new design effort in any way other than queries of how teachers may adapt or react to the new spaces in the future.

Although research study data involving educational environments reveals limited probable effects of the DPE upon student achievement, little of this information reveals teacher responses to the same environments (Bacharach, Bauer & Shedd, 1986) and how these responses may have a significant mediating impact on student actions (Coninger &

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Lee, 2001). If teacher actions affect student achievement as supported in research literature, then it appears that their perceptions of and responses to their DPE are important to consider.

The purpose of this study was to investigate ways in which some teachers may respond to the character of their classroom environments and to depict, categorize and document the consequent efforts they make or steps they take in altering their teaching and/or adjusting their DPE as evidence of their responses. If their responses depict common or unusual reactions, this information may be helpful to administrators and planners as evidence of the needs of teachers and therefore helpful to the promotion of student achievement. Documentation of these reactions may also have a beneficial effect on the design and construction of future school buildings.

Measures of the Designed Physical Environment

The characterization of school classrooms or designed physical environments (DPE), involves many discrete measurable factors including their size, shape, illumination, orientation, sound quality, temperature, ventilation, furnishings, finishes, technological capability and connectivity. American public secondary schools generally range in population size from 300 to 3000 students and a typical school classroom may have between 24 and 34 students depending on the district standards for teacher-student ratios (Johnson, 1990; Lee & Smith, 1997). The following is a description of the six DPE measures used in this study.

Size and Shape - Because building and fire code requirements (UCB, ICBO, latest versions adopted by local jurisdictions) define specific allocations of space per occupant for particular uses such as classroom learning (20 - 25 SF), a popular secondary classroom size is normally 800 to 1000 square feet and measures from 25 (minimum) feet in width to 32 feet or more in length and usually 10 (minimum) feet in height. This size will house approximately 30 students, which is the current typical ratio of students per teacher in American public secondary schools (American Federation of Teachers, 2001).

After a review of the classroom configurations and sizes at the interim site, four general categories of classrooms were designated with their typical sizes indicated. These are: Regular (R - 27' x 32' x 10'), Laboratory (L - 32' x 35' x 10'), Portable (P - 27' x 31' x 8') and Unusual (U - 17' x 32' x 10'). There were other unusual spaces that were used for specific purposes like music, food preparation and shop classes.

Illumination and Orientation - Lighting for classrooms often comes from a combination of electric and natural sources. Illumination guidelines (Illuminating Engineering Society of North America, 2000) suggest that levels within a room must be bright enough for the eye to distinguish text and line work and yet at other times low enough to view computer screens without distracting glare. Glare is caused by a high light to dark ratio of the viewing area (in excess of 3:1) to the surrounding surface. The unit of lighting is a "foot candle" or the amount of light perceived from a candle one foot away. Lighting level recommendations vary both historically and internationally but range from a low of 7 foot candles for computer work to 100 foot candles to distinguish fine text or line work. An average recommended level of illumination within a classroom DPE ranges are 30 - 70 foot candles (Mills, 1993).

The orientation of the DPE affects the amount of solar radiation that enters windows and available views to the exterior. Designations within this study of orientation for constructed rooms were either north (N) or south (S). All of the portables were oriented towards the east (E) with 2 standard size windows only on that side.

Sound Quality - The quality of sound within the DPE should allow an individual to clearly distinguish words when spoken in normal vocal tones. The room should be constructed of materials that diminish or eliminate extraneous sounds from both within and without. Health guidelines within the state of the subject site limit the internal background noise levels within school classrooms to a maximum of 45 decibels ("A" weighted filter) usually caused by mechanical devices (WAC 246-366-110). The sound pressure level of voice or sound that is heard should be 15 decibels above the background noise levels to be clearly distinguishable. This is known as "signal to noise" ratio and is optimized so that the message is heard and to reduce unwanted distractions and avoid

voice strain. The optimum amount of reverberation or echo within the classroom (for sound clarity) is approximately 0.5 seconds. (Acoustical Society of America, 2000).

Ventilation and Temperature - Mandatory minimum air volume changes or ventilation of all habitable rooms is required by building codes (UBC - ICBO). This may be accomplished naturally through exterior wall openings and/or with mechanical means. Often the air within classrooms is mechanically tempered and humidified for comfort within ranges that promote human comfort. Ability to control the temperature setting range may vary with the age of the system and/or policy of the school or district depending on the cost and ease of use. The subject DPE used a combination of natural and mechanical ventilation methods but only the portable (P) classrooms had the capability of being cooled.

Furnishings and Finishes - School furnishings and finishes are pedagogical practice, budget and taste dependent. Furnishings and Finishes may interrelate with other factors such as the size, illumination and sound quality of classrooms as well. They are also affected by district maintenance policies. Teachers at the interim site either used individual desks or 2 person tables for their students for a variety of reasons. Many also used tables (except in the business laboratories) around the perimeter for displays and computers. Being an interim site, budgets for finishes were minimal.

Technological Capability and Connectivity - Full classroom technological capability and connectivity allow teachers and students greater opportunities for a wider range of teaching and learning tools which appear to support academic progress (Salomon & Almog, 1998). To ensure that this occurs, ample outlets and connections to modern equipment should be included within the classroom and school infrastructure.

Despite the age of the subject school at the interim site, the district installed data and power outlets on the perimeter walls within each DPE. Specific locations of equipment were problematic in some DPE but extension chords and telephone wires usually resolved most of the individual concerns.

Individual Classroom Character – As mentioned before, the fundamental characteristics of general classrooms (excluding laboratory spaces such as science, art and

vocational activities) or DPE within a school tend to be similar in appearance for what are termed cultural (purposes, structures and procedures), historical and economic reasons. One culturally related aspect of their character may be described as the necessity to achieve parity among school staff members in maintaining the status quo (Johnson, 1990; Wood, 1992) or perhaps the common acceptance of a general design over a slow evolutionary – historical period (Haskins, 1990). The construction of classrooms units on the same school site through "assembly line" techniques of Henry Ford and Fredrick Taylor utilize a high efficiency of time and materials and usually results in lower construction cost. Unfortunately these techniques often result in physical characteristics of DPE that appear indistinguishable from one another.

These practical and cultural factors may outweigh any altruistic desire to "fit" classroom designs to the spirit of any unique or local traditional, climatic or indigenous features. The resultant physical spaces may adequately meet allocated space needs but may also lack higher affective qualities that reflect individual human identity or charm. Therefore, classrooms tend to be similar in their size, layout, materials and amenities.

Significance of the Study

A significant amount of money is spent annually to update and reorganize schools presumably because those improvements in physical learning environments will result in improvements in student learning. In many cases individual teachers are the primary caretakers of their designed physical environments and their perceptions of what is an adequate and appropriate place in which to teach may play an important part in the quality of teaching that is delivered.

The study's focus dwells on the examination of teachers' perceptions about what is important in and to their individual teaching environments. Many research studies involve an analysis of student effects – DPE relationships usually based on comparative standardized test scores which may indicate student learning. Other environmental behavioral studies involve human effects – DPE interactions involving their health and mental well being in the work place, institutions or home environments. Few researchers

to date have looked at how teachers' mediation of their physical environments may affect how well they perform individually and how this performance may affect student learning.

The significance of this study lies in its contribution to the knowledge base of teacher mediation within their physical environment. State regulations of the subject district assign teachers the responsibility for the health and well-being of their classrooms:

> **WAC 180-44-040** Regulatory provisions relating to RCW 28A. 04. 120 (6) and 28A. 58. 101 -- **Classroom** -- Physical environment. Every teacher shall give careful attention to the maintenance of a healthful atmosphere in the classroom, reporting to the principal or his designated representative any shortcomings in lighting, heating or ventilation. [SBE 44-4-23, filed 3/29/65, effective 4/29/65.]

This study also reveals, through observation and interview, changes that have taken place in several of the DPE which were caused by individual teachers. These alterations, together with teacher responses to perceived needs for their physical environments in which they practice the art of teaching, should have design and layout implications for future school projects, at least within the subject school district. Normally, designers and administrators query teachers about their space and programmatic needs through simple discussions when programming new or remodeling schools. Without deeper reflection and collaboration between teachers and designers, physical arrangements may be based on traditional anecdotal solutions. More substantial evidence drawn from research may have a significant impact on what is now considered critical design criteria for physical environments for schools.

Research Questions

Environmental psychology and behavioral research studies involve human behavior within the physical environment (Moore, 1997). On this fundamental level, teachers react to light, temperature extremes, noise, smells, concerns of privacy and crowding and lack of available teaching tools to accomplish their goals. Zimring (1981)

writes that the fit between the person and the physical environment is affected by the characteristics of the individual and the design of the environment. The following two questions in this study deal with these issues. The first question involves the ways in which teachers may change their physical environment to fit their needs and the second speaks about the teacher changing the way they would normally perform their job because of the physical landscape:

1. In what ways do teachers change or rearrange their individual designed physical environments so that they may have a sense of well being (i.e. feel healthy and focused?)
2. In what ways do teachers adapt their behavior within individual designed physical environments so that they may have a sense of well being (i.e. feel healthy and focused?)

The next question involves interactions with others at the school that may be based on social or cultural constructs of the teacher. These may be affective rather than cognitive reactions. These reactions may not be easily put into words but involve the social and cultural background of the subjects. These perceptions may also involve the local culture and character of the particular school site.

3. What are teachers' perceptions of the overall designed physical environment's social or cultural value (both within and without the classroom) with respect to accomplishing their teaching goals?

The last research question was used in both the questionnaire and the interviews and was intended to reveal what subject teachers felt was most critical to their work environment. Forcing a prioritization of only one choice from subjects may reveal what is most important to consider when planning new school environments.

4. What features or characteristics of designed physical environments do teachers perceive and identify as most important?

The next chapter includes a review of current relevant literature on the measures used in this study as well as information about human interactions within physical environments.

CHAPTER 2 - REVIEW OF THE LITERATURE

This chapter begins with an introduction to the literature used as a basis for the theoretical construct of this study and describes literature that informs the identification of the six measures used to access the DPE. The chapter also discusses literature regarding behavioral and social interaction within the physical environment, a discussion of teacher mediation and a conclusion.

Introduction and Theoretical Background

The study of interactions between people and their physical environments for the purpose of understanding and improving those relationships is a general goal of environmental psychology as well as the intent of this study (Bechtel, ed. Craik & Zube, 1976; Evans and Garling, 1991; Heft, ed. Moore & Marans, 1997; Reed, 1988).

Architectural design and environmental behavioral theories differ in intent and application. Architectural theories relate to guidelines or principles for ordering space and environmental behavior theories involve testing through empirical data gathering on how space is perceived and used. Environmental behavioral (EB) and architectural theories can and should be integrated for three purposes: EB research can inform architectural design theory; design theory can raise EB research questions and some EB and design theories can be integrated and tested (Moore, 1997).

Research on Measures DPE

Most of the background literature is drawn from studies conducted within work environments but some specifically involved school studies. The school environment studies have been noted. As previously mentioned, the six measures were developed in a master thesis and pilot studies, and refined based on the literature review.

Classroom Size

The size of a designed physical environment (DPE) or classroom may affect both an individual's physical well being due to crowding or privacy concerns as well as supporting or possibly thwarting planned activities within the space (Zimring, 1981). The actual size may differ from perceived size. Size issues in school classrooms may refer to

actual square footage as well as the number of students (Duke, 1998). The number of students per teacher within a room may also relate to student achievement (Achilles, Finn & Bain, 1998).

At least three factors can influence perceived crowding and actual DPE size: 1) density and volume - usable space or room size less circulation area and pieces of furniture; 2) visual exposure, brightness, perimeter openness and view or window placement and orientation (direction the room faces) and 3) elevation or floor level. Although the dimensions of rooms were the same, users made a distinction between the feeling of being crowded and actual density yet this perception did not necessarily relate to the size of a space (Evans & McCoy, 1998; Shiffenbauer, Brown, Perry, Shulack & Zanzola, 1977).

Spatial aspects of the "self reported" desire for privacy within interior spaces include a need for a reduction of noise levels and some physical separation from others. Privacy is sought to reduce stress levels in an effort to "feel better" as well as for creative or preparative activities. These efforts may include inter-social activities or simply being alone between .5 and 3 hours. It is necessary for some to have the ability to control one's privacy either through verbal communication or physically via a locked door (Newell, 1994). Although there was no mention of size criteria in this study, it is evident that adequate room for teachers to work without being disturbed and separation from students and colleagues are important issues to consider.

Insufficient spatial resources, inflexible arrangements and lack of climatic or lighting controls threaten individual needs (Hedge, 1991: Sherrod & Cohen, 1979 as cited by Evans & McCoy, 1998) and prolonged experiences with uncontrollable DPE is associated with learned helplessness (Cohen, Stokols & Krantz, 1986 as cited by Evans & McCoy, 1998).

Illumination

In a recent daylighting study that included three school sites, remarkable student academic gains were reported at two of the schools in southwestern climates. However, a third school located within the same northwest climate as the school in this study, showed

less favorable academic gains. The daylight study has not yet included information about teacher preferences to the day lit classrooms where student gains were reported (Heschong Mahone Group, 1999).

When given the opportunity to control glare on computer screens within a windowless office workstation environment, subjects reduced perceived glare. Although there was no apparent short-term benefit, it appears that experience with workplace conditions could lead to the ability of the occupant to reduce unpleasant conditions if choices were available (Veitch & Newsham, 2000).

In a later study conducted in the same type of windowless environment, deviations between participants' lighting preferences and the lighting they experienced during the day was a significant predictor of participant mood and satisfaction. No fixed illuminated environment (non adjustable) can match user preferences of more than 50% of occupants. Only some form of individual control will allow all occupants to match lighting conditions to their own preferences (Newsham & Veitch, 2001).

There is no clear evidence of an altered short term work performance due to the color temperature (warm, cool, natural) of the light source, although lamp color-temperature preferences appear to be gender related (Knez, 1995; Vetich & Gifford, 1996).

User choice and preference of illumination types (direct/indirect/color) appeared to be inversely related to performance in a given workstation lighting condition. In other words, if users are given more *choice* about the amount of lighting and the type that they prefer, their performance (in limited measures) in a work setting diminishes (Becker, 1991 as cited Veitch & Gifford, 1996). This may be due to a fear of making poor or wrong choices about appropriate lighting that may also affect performance (Averill, 1973, Paciuk, 1989, Burger, 1989 as cited by Veitch & Gifford, 1996).

Sound Quality

Schools located in noisy environments show poorer student academic progress (affecting teacher project goals) than those in quieter environments (McGuffey, 1982).

Chronic outside noise exposure affects students' reading ability. Children in a school near a noisy airport flight path had poorer reading skills than children from a quiet school. Both schools had similar demographic profiles. Children at the noisy school were also not good at distinguishing speech masked by white noise but were able to distinguish specific sounds (e.g., cat meowing, baby crying). Language skills related to speech appeared to be related to reading skills. All children were tested in quiet conditions thereby confirming that chronic noise, and not acute noise, is related to academic achievement (Evans & Maxwell, 1997).

Sound within a work environment that is considered normal or necessary may be distracting to the task at hand but not so annoying as to be deemed unnecessary by workers in a variety of environments. If individuals feel that noise could or should be controlled, it is even more distracting and annoying (Kjellberg, Landström, Tesarz, Söderberg & Akerlund, 1996). Noise that is predictable and controllable allows one to adapt to it and thereby reduces stress. The context for noise is just as important as the level of noise (Gawron, 1982; ; Green & Fidell, 1991; Moch-Sibony, 1984; Thompson, 1981; Vallet, 1987; Weinstein, 1976 as cited by Kjellberg, Landström, Tesarz, Söderberg & Akerlund). The actual physical conditions that produce noise are of less importance than user perception of the quality of the building environment (Gonzalez, Fernandez & Cameselle, 1997).

Temperature & Ventilation

Temperature – high and low (uncontrolled) temperatures within the workplace together with unwanted noise were found to be the most annoying influences to occupants. Ventilation and lighting however, were of less concern to user satisfaction than temperature and noise (Gonzalez, Fernandez & Cameselle, 1997). Air quality may relate to ventilation that is also associated with smells and odor or "over stimulation" (as mentioned in Evans and McCoy's 1998 study) that may be considered stressful. Specific issues of ventilation or temperature control did not appear in any studies that were reviewed. However, Evans suggests that physical constraints that reduce choice or

behavioral options can produce or exacerbate stress (Glass & Singer, 1972, Evans & Cohen, 1987 as cited by Evans & McCoy).

Finishes & Furnishings

Several studies reviewed involved issues of perception and judgment where a distinction was made between affective and cognitive perceptions of the environment by the users (Ritterfeld & Cupchik, 1996; Evans, & McCoy, 1998). School design and construction must include both the practical and to the "immaterial, the spiritual and affective" needs (Uline, 2000).

Users who consciously evaluated a space rather than emotionally reacted to it, were more objective or detached and could therefore better describe the qualities of the physical environments. Categories of style including a variety of finishes and colors that were labeled within three categories from highly decorative ("stylistic") to austere ("modern") with a majority of participants preferring the middle ("familiar") style range (Ritterfeld & Cupchik, 1996). The type of work task was considered the main determinant for subject's mood and performance when considering the importance of privacy and the arrangement of the components within the physical environment (Kupritz 1998).

In a comprehensive national survey sample of 1,050 teachers, sponsored by the Carpet and Rug Institute and the International Interior Design Association Foundation, respondents felt that good interior design planning leads to better learning environments and that well designed classrooms improve learning and achievement (Schaprio, 2001).

The "Soft Classroom" university based study involving unique non standard furniture layouts and textural finishes revealed changed behavior in the form of increased interaction among occupants. Like the dormitory study (Shiffenbauer, Brown, Perry, Shulack & Zanzola, 1977), the size of the space was similar to other classrooms but major changes involved arrangement of furniture (perimeter bench seating rather than rows of student desks) and room finishes (carpet and soft drapes instead of floor tile and blinds). These changes appeared to affect student and teacher perceptions and behavior and were preferred by those who utilized the space. Some instructors preferred standard classroom spaces for the purpose of testing and lecture formats, and avoided the "soft

classroom." Criticism of the space also included poor ventilation, which was common in other classrooms as well. Student performance was not measured (Wong, Sommer & Cook, 1992).

Tools-Technological Capability and Connectivity

Better access to some technological devices (telephones and photocopy machines) had an ameliorating effect on teachers' perceived levels of influence and autonomy as well as their perceived levels of efficacy and achievement (Tuettemann and Punch, 1992).

The integration of technology into the classroom only occurs if the adoptions were related to teachers' beliefs that they would empower themselves (Savenye, Davidson & Orr, 1991, 1992; Sanders & Stone, 1986; Canning, 1989 as cited by Davidson & Ritchie). Conversely, teachers will not use new technological devices if they are not perceived of any benefit (Collis, 1988 as cited by Davidson & Ritchie).

Learning new technologies became more effective if and when teachers could see it align with personal or curricular goals, have technical support available when needed (Shelley, 1998); develop skills in conjunction with other teachers both within their own and in other schools, be willing to change personal (proven) instructional approaches, assessments and management strategies (Wiburg, 1997) and involve the support of administration and community in this effort (Davidson & Ritchie, 1994; Wiburg, 1997).

The costs of technological implementation and integration to teachers is expenditure of time, on both a personal and professional level (Johnson, 1990); vulnerability and loss of efficacy, as hinted in Wiburg's (1997) study where a professional teacher has to be willing to "give up" proven strategies that have worked in the past; risk of failure that one's goals and the help needed to achieve them may not be possible (Shelley, 1998); and loss of respect if school administration and community are not supportive (Davidson & Ritchie, 1994).

Classroom environmental controls, infrastructure cabling for computer networking, telephones, fax machines, TV's, VCR's, DVD's, photo copy equipment and even individual computers themselves may be perceived as part of the school facility or the physical environment and used to support teacher project goals. Currently many

devices are mass-produced and are becoming more affordable and portable, so that they can be used in a variety of settings by students and teachers outside of the school as well. As their use by teachers increases over time, they will inevitably become more common as the traditional chalkboard as standard teaching tools (Riley, 1996).

Two thirds of the teachers who took part in Janine Shelley's workshop study (1998) already had e-mail addresses. Two thirds of the parents and children had computers at home and 60% of the teachers availed themselves of a district program to take computers home (Davidson & Ritchie,1994). Millions of dollars are currently allocated from the Gates Foundation to train and equip teachers in the use of technological tools in the classroom.

Behavior within the Physical Environment

The quality of the designed physical environment (DPE) that is perceived by teachers appears most relevant or recognizable when it directly impacts their teaching activities or, as Evans and McCoy (1998) note, allows them a level of "affordance." They appear less aware of the more subtle or ambient features of the environment although its level of quality may have an effect on their behavior (Duke, 1998).

Individuals have a wide range of personal, behavioral, cognitive, and social goals in any given situation. When people perceive a "misfit" or they feel that their goals are being thwarted, they adopt a coping or adapting strategy that is influenced by the qualities of the situation, past experience and other characteristic variables. The design of the physical environment may directly support or thwart a user's goal. Users have two choices when faced with a misfit within the environment: 1) they may change their needs through intra-personal means or 2) change the situation (Zimring, 1981).

One commonly accepted theory in environmental behavioral research is described as an "ecological" approach to the theory of perception inspired by J. J. Gibson (1979). This theory suggests that users perceive the physical environment in a "relational" or reciprocal way in which they are integral within their surroundings and a continuous interaction or mediation takes place. This theory gives weight to physical stimuli that have a direct effect on the users who continually interact with the environment.

Another theoretical approach has it roots within the "constructivism" realm or what may be termed "mental representational" views of the environment which suggests that the person and the environment are conceptualized independently of one another with an internal variable (within the person) which mediates between stimuli information and behavioral activity. This view claims that stimuli are "in" the environment and experience of the environment is "in" the mind of the perceiver (Heft, 1997).

Behavioral "reactions" to the physical space itself as they may relate to a feeling of well being or self preparedness include topics such as finish materials, physical arrangement and space utilization, density, privacy, color, style, shape, ambient light, temperature, ventilation and noise (Evans & McCoy, 1998; Jue, 1990; Klitzman & Stellman, 1989; Ritterfeld & Cupchik, 1996; Schiffenbauer, Brown, Perry, Shulack, Zanozola, 1977; Wong, Sommer & Cook, 1992; Zimring, 1981).

References regarding the effects or impacts upon teaching "projects" (Friedman, 1991; Gorrell, Bregman, McAllister & Lipscomb, 1985; Tuettemann & Punch; 1992; Williams, 1995) include descriptions about teachers' needs for access to equipment and supplies, private work areas and the quality of amenities relevant to teachers within the school. Office workers provided with proper equipment also report reduced dissatisfaction (Harris, 1980 as cited by Klitzmand & Stellman, 1989).

The effects of the age and cleanliness of school facilities appear to have an inverse effect upon each other, but only cleanliness had a relevant effect upon teacher behavior (Friedman, 1991; Maddox, 1996).

The type of work or task that is necessary was considered to be critical when evaluating the level of distraction and annoying noise as well as the expectation of its repetition (Kjellberg, Landström, Tesarz, Söderberg & Akerlund, 1996). In other words, concerns for the purpose of the work task or activity outweigh the annoyances generated by the elements within the environment. If teachers are forewarned or know that certain activities that generate noise are or will take place, they are less apt to be disturbed when the distractions occur.

New technologies can be powerful means in developing better learning environments for all students (Willetts, 1992 and Woodward & Gersten, 1992 as cited by Wiburg, 1997) when tied to instructional materials that support a constructivist model of learning (Cognition & Technology Group at Vanderbilt, 1992; Willetts, 1992; Woodward & Gersten, 1992 as cited by Wiburg, 1997). However current technologies sometimes appear to exist as "isolated products, with a school-based curriculum tied to well-designed instructional strategies" (Wiburg, 1997). Wiburg quotes Fullan (1996) who advocated neither a top-down nor bottom-up strategy for educational reform but rather the forming of "kindred spirits" (p. 174) through small groups of individuals coordinating and intersecting to affect change in complex systems such as school districts.

Social and Cultural Interactions

Klitzman & Stellman (1989) separated variables in their office environment study into physical and psychosocial working conditions and found that the physical or ambient working conditions (most notably air quality and noise) related more toward what they call psychological well being or the health of the workers and what they call "job satisfaction" was not adversely affected by the physical characteristics of the environment but related more to the social or office culture. They admit that there was no clear separation between the effects of the psychosocial and physical on worker stress within their study and that other factors including participation, social support, personality and experiences outside of the work place may also have an effect.

Teacher reactions to their classroom spaces may relate longitudinally within the physical environment as in the case of district/school policy that evokes a particular curriculum delivery style (Friedman, 1991; Wong, Sommer & Cook, 1992) school/class size (Caldus, 1993; Finn & Achilles, 1990; Fowler & Walberg, 1991; Garbarino, 1980; Lee & Smith, 1997; Newmann, Rutter & Smith, 1989) or grade level/special program that affect school layouts (Friedman, 1991; Gorrell, Bregman, McAllister & Libscomb, 1986). Conversely existing building arrangements or quality may encourage or prevent social and pedagogical interactions or may be inadequate to support a particular size or program (Jue, 1990; Tuettemann & Punch, 1992; Williams, 1995).

The effective use of a space setting or DPE is depicted in what is called a space "program" that specifies a set of rules for interaction among people, the roles they play and their relationships. These rules may be indicative of embedded social and cultural processes that may be studied and observed (Canter, 1991).

Architectural theories suggest that building designs exhibit social and cultural symbolic meaning (Norberg-Schulz, 1965; Markus, 1987). Office environments are often conceptualized by traditional standards based on layout, technology and ergonomics but final design decisions are actually driven more by meaning or relative status of the occupants. Examples of cultural changes to individual office placement status within large corporations have to do with the reorganization based on "cross-disciplinary collaboration." Prior to this groups of employees used to be identified and given space by a job classification title (i.e. functional or professional status) but now are shifting to a grouping based on project or problem solving integration teams (Zimring & Peatross, 1997). This corporate cultural change in office layout environments may have a parallel meaning with cultural changes taking place in schools where teacher interdisciplinary groupings have been evolving from individual classroom ownership and sharing as is the case at the subject site.

Distinguishing the natural environment from the cultural one in anthropology and ecology sciences is interconnected by material and non-material (Gibson, as cited by Reed, 1988) but perceived through the senses. The definition of decent school facilities must go beyond the "narrow and miserly" practical needs, allowing the art and science of school design to include "immaterial" ideals as well as the practical physical functions (Uline, 2000).

Final Overview, Teacher Mediation and Conclusions

Carroll McGuffey (1982) conducted a comprehensive review of school environmental research data in which he concluded that there is a definite relationship between the physical environment and student achievement. His review took into account many of the sub categories noted in this study including what he labeled: "building age, thermal factors, seeing factors, color and interior painting, hearing factors, amount of

space, open space, windowless facilities, underground facilitates, site size, building utilization and maintenance, support and special instruction facilities and the overall school size." Two conclusions were reached: 1) obsolete and inadequate school facilities detract from the learning process and conversely; modern, controlled physical environments enhance it and 2) facilities may have a differential impact on the performance of pupils in different grades and for different subjects (McGuffey, 1982).

McGuffey admitted that the variance that could be accounted for in each research study was small but suggested that the accumulative effect may be significant. Many of what he reviewed were older studies that were measured by standardized aptitude, achievement and IQ tests across a wide range of grade and age levels. Many of the studies controlled for a variety of variables including social economic status, age, gender and cultural background but none mentioned the involvement of teacher characteristics, perceptions or possible mediations of their DPE.

Teachers play an critical role in the mediation with students of their school work environments. A few of these mediation activities include district restructuring reforms (Olsen & Kirtman, 2002), technological tool implementation (Salomon & Almog, 1998), multicultural integration reforms (Grant & Wieczorek, 2000) and everyday student support and guidance (Croninger & Lee, 2001).

In a prior pilot study at the original school site involving 11 of the same subjects (36% of the current study), all of the teachers interviewed responded that 1) they had a direct influence (averaging 60.8% effective) on a portion of their students' learning progress and 2) that their prior teachers had a similar impact on their own learning (Lang, 1999). From the prior study, it is clear that many teachers perceive that their presence within their DPE has an impact upon student academic progress. It was vitally important then, as a basis of the current study, to observe and measure the perception teachers may have about the impact of the designed physical environment upon their abilities to function and perform within their own teaching spaces.

Finally, an important aspect of this study was the disruption experienced by this group of teachers when they were disturbed and uprooted from the original school site.

Although not all, many of the teachers had permanent or semi-permanent spaces for several years within the historic building. As Zimring, (1981) stated, changes are made in the physical environment when a "misfit" is perceived by the user. Forcing teachers to move from their original school site to an interim one allowed them the opportunity to rethink their classroom layouts and be able to articulate more clearly their feelings and needs within these spaces. However, it is reasonable to believe that the temporary nature of this space may have discouraged them from investing inordinate effort in achieving their spatial needs.

CHAPTER 3 - METHODOLOGY

This chapter includes the measures and protocols used to record teachers' perceptions of and interactions within their teaching spaces. It was preceded by a pilot study involving 18 of the same subjects from the original historic school site. This chapter is broken down into the following sections describing the pilot study, exploratory case study, protocol measures, data collection, coding and validity, and reliability of the study.

Pilot Study

The pilot study (Lang, 1999) was the first attempt to construct and test the protocols for the instrumentation and methods used as a basis for this dissertation study. The pilot study took place at the original historic school site whereas the dissertation study took place on the interim site. The historic site's typical classrooms were more centrally located within the early 20th century landmark building and special classrooms and laboratories were located in later 50s and 60s additions, which were torn down in the remodel (see Figure 4).

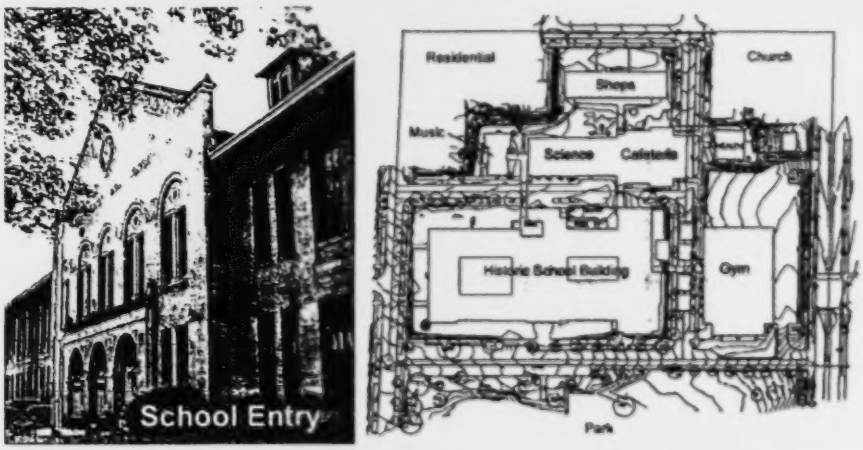

FIGURE 4. Original historic school site

A comprehensive questionnaire (113 general and 8 demographic questions) was sent to 20 secondary teachers with a follow up "clinical" interview (14 questions) with 19

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teachers (one declined to be interviewed). Teachers were asked, among other things, about their individual philosophy or motivation for teaching, what elements within the physical environment they believed had an effect upon student learning and how much of their students' learning depended upon themselves. No attempt was made to measure individual teacher performance or the influence of the work place itself upon teaching or learning.

Six measurement categories were developed and tested during the pilot study. The six protocol categories used to measure teacher perceptions about their DPE are described in terms of perceived appropriateness and classroom qualities along the following aspects:

1. Size - Layout - Adequate room and flexibility for teaching
2. Light - Glare - Adequate control of the amount of illumination and contrast
3. Noise - Acoustics - Sound quality and isolation of noise within and without
4. Temperature - Ventilation - Adequate control of temperature and ventilation
5. Finishes - Furnishing - Quality and flexibility of finishes and furnishing
6. Teaching Tools - Communication - Adequate electrical and data outlets, marker and pin up boards, access to copy machines, telephones, e-mail and other communication tools that help structure and organize teaching activities.

The results of the pilot study indicated that there was strong agreement among this group of teachers about their role as mediators of student learning in terms of their physical environment. These included the need for private reflection and preparation spaces (90% moderately-strongly agreed); teaching tools and materials close at hand (95% strongly agreed) and the dissatisfaction with sharing (not at the same time) a classroom with other teachers (79% moderately-strongly agreed). Other salient issues of the DPE perceived by teachers affecting student learning included having cleanly maintained rooms (89% moderately-strongly agreed), areas to display student work (90% moderately-strongly agreed) and the ability to have a view to the outside (95% moderately-strongly agreed).

Exploratory Case Study

Teachers at the subject school were relocated to an interim site for two years while their previous school site was being renovated. The interim site is very different in character from the previous environment (see Figures 4 & 5) as classrooms and laboratories are arranged in a series of linear corridors and wings dispersed over a wide area.

FIGURE 5. Interim school site

Subject teachers were recruited from every school department and appeared to be representative of the school staff. 31 teachers (60% of the entire staff), agreed to take part in this study. Staff characteristics are further described in Chapter 4.

The protocols for the exploratory case study, which were refinements of the ones used in the pilot study, were conducted in three parts. An initial questionnaire was distributed to volunteer teachers, observations took place within their classrooms and a follow up clinical interview (see Appendix B for examples of each) was conducted after the observations. Human subjects investigative guidelines were followed throughout the study with permission granted from the school district, principal and individual subject teachers (see Appendix A).

Protocol Measures

Questionnaire

Portions of the pilot study questionnaire were deleted and others simplified to help focus the theoretical approach of this dissertation. It was reduced to 21 general and 8 demographic questions. Each of the six categories contained three to four questions each. There were 17 items on a five equal step Likert scale, 3 true or false questions and 1

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forced choice item regarding the "most important quality." The survey also included a limited demographic portion (see Appendix B for the complete questionnaire).

All but one of the Likert-type questions asked subjects to make a choice using the following descriptors about the quality or character of a subjects' room (on a five point scale) with 1 point given for "very dissatisfied," 2 for "moderately dissatisfied," 3 for "neutral feeling," 4 for "moderately satisfied" and 5 points for "very satisfied."

All of the scaled step scores were compiled and the frequency of responses recorded. Responses were summarized and the means, modes and medians were calculated for each item. Results were then compared and cross-tabulated against demographic data.

Teacher demographic data included years of teaching experience within the subject school, the district and current lifetime. Data about their age, years of education, highest degree obtained and teaching specialty or area was also collected. Gender was determined during the observation portion of the study.

Observations

Appointments were arranged with each teacher to quietly sit in their rooms during class instruction. Interactions between the observer and others were kept to a minimum, usually only to explain the observer's presence. Length of sessions lasted from 30 to 50 minutes depending on daily activities within the space. A description of each of the six measures was noted along with the time of day and climate (see example in Appendix B). The amount of room personalization, classroom activities, number of students and teacher interactions within each space was also noted.

Between interviews and observations, each room was fully photographed. Some of the more standard rooms were measured and the rest were scaled from these and existing diagrams. The amount of illumination in three of the typical rooms (portable, regular south and regular north class types) was metered. Acoustical and temperature measurements were also recorded in a typical regular north classroom in both occupied and unoccupied states. The observation data was used to verify subject responses to the questionnaire and the interview in context.

Follow Up Interview

The clinical interview questions (11 total see Appendix B) were similar to the pilot study and were open-ended allowing for discussion about issues dealing with teacher mediation of six measures of the individual teaching space. One question dealt with the overall school layout and two questions repeated the questionnaire's "forced" choice about the most important quality within their DPE but were asked from opposite view points (best vs. worst qualities). Further comments about teachers' perceptions were requested if the subjects desired to do so.

Data Collection and Coding

Permission to conduct the study was initiated at the district level and then with the school principal who allowed an announcement to be made at a monthly teacher meeting in the school library. After only three initial teacher responses, face-to-face solicitations were made and eventually 31 of the approximately 52 teachers agreed to take the questionnaire, be observed and be interviewed. Of the 31 teachers, 5 did not respond to their questionnaire. All 31 teachers were observed and interviewed. Due to schedule conflicts, one teacher agreed to be interviewed over the telephone.

Survey questionnaires were given to the teachers in April 2001. Observations and interviews began May 11th and were completed June 20th, 2001. Measurements of the rooms continued through the summer and fall of 2001. Observations and interviews of the subjects were conducted at all times during the typical four-period school day (7:40 AM to 2:15 PM) and towards the warmer months of the year (May and June) although cool and overcast mornings were typical. Climatic data was noted in each observation session.

Personal information including teacher names and room numbers were recorded until the data was coded and then later destroyed. All of the subject teachers signed permission slips to take part in the study. Teachers were assigned numbers from 1 to 31 in the order that they were observed.

Rooms were designated as one of four types depending on their use, construction and orientation. The basic types of classrooms were labeled regular (R), unusual (U), portable (P) and laboratories (L). The rooms labeled as laboratories, were special use

rooms and were generally larger than the others. Orientation of the windows of the permanent regular and laboratory rooms were either north (N) or south (S). Portable classroom windows all faced east although their doors faced both the east and west. The unusual classrooms in this study only had windows that faced south.

During observations the amount of teacher personalization to their classrooms were recorded in notes and photographs. A coding system was devised for each classroom evaluating the extent of alteration or personalization based on a five part scale from 0 = the least amount to 4 = high degree of alteration.

Coding of teacher responses in the follow-up interview was organized according to answers relating to the six measures and whether the DPE was perceived positively or negatively. Subjects were given freedom in their response choices during the interview, consequently their responses varied from one answer to several for each question. Judgements were made after the interviews and observations as to what degree or affect the six measures had on either teachers' changed physical environment or on ways teachers conducted their routines. These judgments were recorded on the interview notes and summarized as part of the analysis shown in Appendix C.

Validity and Reliability

This dissertation is a case study exploring the perceptions of a small group of teachers within a school building on an interim site. A weakness of this circumstance may be that this situation is too unique and results cannot be generalized. A counter argument in support of this approach asks the rhetorical question, "Do fish see the water?" In other words, do most teachers really notice their DPE surroundings, especially if they have already mediated their classrooms over several years?

Piaget (1954/1971) contended that learning occurs when we are somewhat uncomfortable because we wish to discover the cause of the discomfort and reestablish our equilibrium. Through mitigating circumstances, teachers at the interim site were made uncomfortable by being uprooted from their prior environment and forced to mediate within a new one in order to meet their societal responsibilities of helping students to

learn. It can be argued that teachers at the interim site were therefore more sensitive to questions and responses about their DPE and were able to more clearly articulate their physical environmental needs than teachers ordinarily do.

All of the teachers were volunteers and had equal opportunities to take part in the study. The sample that responded appears to be representative of the entire teaching staff in the areas of gender, ethnicity and advanced degrees held. Teachers who took part represented all departments or teaching areas within the school.

The results of this study may be applicable to teachers within this school, other high school teachers within the district, teachers who may be involved in schools undergoing modernization and those entering newly designed schools, it provides insights to teachers who wish to learn more about clearly articulating their teaching needs in concert with their physical surroundings. Study results may also be important to administrators and facility planners involved with the study and layout of new learning spaces.

CHAPTER 4 - PRESENTATION AND ANALYSIS OF DATA

Chapter 4 presents the results of data collected from the population of respondents in this study (31 teachers) and is broken down into the following categories: demographics, overview of data analysis, six protocol measures, teacher priorities and summary of data.

Demographics

Personal demographic data requested from respondents included their age, years of teaching experience, education and teaching specialization. Teacher gender and type of classrooms in which they taught was noted during observations and interviews.

The total number of permanent teachers at the subject school during the time of this study was 48 with some regular substitutes and interns bringing the overall total teaching staff to approximately 52 teachers. This study included 31 teachers, interns and substitute teachers or 59.6% of the total staff. The gender profile for the school was 25 female and 26 male and this study included 16 female and 15 male subject teachers. The school profile lists 50% of the teachers with advanced degrees as compared to 58% with the same qualifications within this study.

No ethnic or cultural data was gathered because a large number (87.5%) of the teachers within the district profile literature are comprised in the category labeled "white" and the subjects in this study appear comparable (a majority were Caucasian with 2 to 3 subjects who appeared to have a different ethnic-cultural background). Results of previous studies involving reactions to physical stimuli or environmental psychology revealed little significant differences based on ethnic or cultural background.

A majority of the teachers surveyed were over 30 years of age and the breakdown of their age groupings is included Table 1:

TABLE 1. Age Demographics

<25 of age	25-30	31-40	41-50	over 50+
10%	6%	26%	36%	32%

Most of the teachers surveyed had taught less than 5 years at the subject school but had been teachers much longer and practicing within the district for more than 5 years. This is displayed in Table 2:

TABLE 2. Teaching Experience

Years Teaching at the School				
<5	6-10	11-15	16-20	20+
54%	29%	17%	0%	0%

Years Teaching within the District				
<5	6-10	11-15	16-20	20+
34%	25%	29%	4%	8%

Total Years of Teaching				
<5	6-10	11-15	16-20	20+
24%	25%	25%	13%	21%

Areas of specialization were broadly represented within the study with business, language arts, science and social studies teachers having the most participation. All departments within the school were represented. Several teachers (4) taught more than one subject as shown in Table 3:

TABLE 3. Teacher Expertise

Teaching Area	Number of Teachers
Bilingual Education*	1
Business*	4
Home Economics	1
History	3
Language Arts	5
Visual/Performing Art	3
Math*	3
Science*	6
Social Studies*	2
Special Education*	2
Technical Education*	2
World Language	1
Physical Ed./Health*	2

*Teachers in these areas taught more than one subject

Overview of Data Analysis

Initially the intention was to correlate the six spatial measures with an assessment of the degree to which teachers altered their surroundings. However due to the small size of the sample, achieving significant correlations was not possible. Therefore, only the percentages of response are reported related to each of the six measures to show their relative importance to the subject teachers. In the conclusions, a theory is utilized to place these exploratory findings within a broader conceptual framework.

The demographic data reveals an experienced subject teaching staff, representative of the entire school by gender and drawn from many teaching specialty areas. There were three common types of classrooms at the subject site. These included a regular (**R**) classroom, a portable (**P**) classroom and laboratory (**L**) or shop spaces that were usually larger than regular classrooms. Some usual (**U**) teaching spaces were also observed that included special or temporary functions (music, journalism, ESL, student store, etc.).

The permanent classrooms' compass orientation at the subject school was either north or south facing. Portable classrooms all faced east. The number of subject teachers, designations of room types and dimensions within these rooms are shown in Table 4:

TABLE 4. Classroom Types

Number* of Teachers *n=31	Types of Classrooms and Orientation		Sizes of Classrooms
4	**RS**	Regular – South facing	27'4 x 32'2 x 9'8
6	**RN**	Regular – North facing	27'4 x 32'2 x 9'8
5	**P**	Portable – East facing	26'6 x 30'8 x 8'0
6	**LS**	Lab – South facing	32'-35' x 32'2-39'2 x 9'8
7	**LN**	Lab – North facing	33'-47' x 32'2-38' x 9'8
3	**US**	Unusual type – south facing	17'2-34' x 32'2-41' x 9'8

Approximately half (48%) of the subject teachers were in regular or portable type classrooms that were all similar in size, and 1/3 shared their teaching spaces for at least one period of the typical four period day.

Most teachers responded positively to questions in the survey concerning the size & layouts of their interim rooms. The rooms were generally larger than the rooms they had in the previous school year by at least 12% and some were also given the opportunity to layout their interim spaces before the school year began. There were mixed results on teacher reactions to classroom character regarding lighting - glare, noise - acoustics and finishes - furnishings (see Questionnaire responses in Appendix C).

In the following paragraphs the Likert-type descriptors labeled "moderately" and "very" were occasionally collapsed together for a general view of overall combined "satisfied" and combined "unsatisfied" response answers for comparison purposes. Neutral response answers were not included in these comparisons.

Overall, teachers were more positive (22.7% of total satisfied combined response answers) in their perception of classroom qualities than they were negative (16.5% of female and 14.7% of males teacher indicated unsatisfied combined response answers). Teachers with 16 to 20 years experience gave the least negative (13.2% unsatisfied response answers) and most positive (23.5% satisfied response answers) about the character of their classroom environments than those in the 4 other years of experience categories. Of the three largest groups of teachers divided by teaching area, language arts teachers had the most positive responses (30% satisfied answers, 16.2% unsatisfied answers), science teachers were less positive (26.5% satisfied answers, 20.6% unsatisfied answers) and business teachers were the least positive (23.5% satisfied answers, 24.3% unsatisfied answers) about the character of their existing classrooms.

Data about the Six Protocol Measures

Size - Layout

A strong response by teachers for the ability to rearrange their furniture within a large enough classroom DPE was noted in questionnaires, observations and interviews. Responses indicated that a majority (68%) of teachers felt they were able to move student desks around to meet their needs and 50% of the teachers were satisfied with their room flexibility within the larger (interim) classrooms. This view was also well supported in

responses to interview questions as teachers brought up issues regarding classroom size and student furnishings a combined 239 times.

Of the 34% of teachers who responded that they were unable to adequately move student desks, 2/3 had fixed counters that restricted flexibility and the other 1/3 were in very small classrooms. A follow up interview question asked teachers about differences between their present and previous year room layout organization and 32% responded that their room arrangement was the same despite an entirely different classroom DPE.

Ceiling heights within the interim school were perceived to be "too low" by a few of the subjects especially those in portables where ceilings were 8'. The original historic school site had much higher ceilings by comparison and was also an entirely different (Romanesque) style than the more "modern" style school construction of the interim site.

Lack of space for classroom activities in a few cases (36%) caused a perceived hindrance of teaching goals. In some this was due to the size of the DPE and in other instances because of additional equipment (usually computers) that were introduced at this site and in other instances limitations of outlet locations (which necessitated the addition of extension chords).

TABLE 5. Responses* about Current Classroom Size - Layout

Likert Scale	Adequate Passive Space	Adequate Flexibility	Adequate Active Space
1	2	5	5
2	6	4	10
3	1	4	11
4	9	8	0
5	8	5	0
Median	4	3.5	2
Mode	4	4	3

*Subject responses n = 26 (5 teachers did not respond to the questionnaire)

Note: 1 = Very dissatisfied 2 = Moderately dissatisfied 3 = Neutral feeling 4 = Moderately satisfied 5 = Very satisfied

Teachers were generally satisfied in their responses to the questionnaire with

classroom space for passive activities (65% satisfied combined response answers) but mixed about flexibility and dissatisfied with their space for unique or special activities (see Table 5). In response to interview questions about the character or qualities of their classrooms, teachers spoke about the need for adequate area within their room more times (147 total, See Appendix C) then any of the other criteria.

Light - Glare

The most notable feature concerning the (existing) classrooms and one with which teachers were most happy, was the quality of natural illumination from the window wall (see Table 6). A few rooms also had diffused sunlight from overhead skylights on the opposite end of the room from the window walls. This was appreciated by teachers who were asked during the interviews about favorable room qualities. Conversely, the portable classroom teachers only had two small east facing windows. By observation, most of the classrooms had functional horizontal blinds which teachers adjusted to reduce the often bothersome glare from the daylight. There was a strong negative response from the teachers with their inability to control the electric lighting in their project goal domain as evidenced both in the questionnaire responses and interviews.

TABLE 6 Responses* about Current Classroom Light - Glare

Likert Scale	Adequate Illumination	Bothersome Glare
1	1	1
2	3	4
3	5	3
4	9	10
5	8	8
Median	4	4
Mode	4	4

*Subject responses n = 26 (5 teachers did not respond to the questionnaire)

Note: 1 = Very dissatisfied 2 = Moderately dissatisfied 3 = Neutral feeling 4 = Moderately satisfied 5 = Very satisfied

Teachers were satisfied with the quality of light and with their ability to control

glare in response to the questionnaire but 57.7% were unhappy with their ability to control the illumination given in a true-false answer. Illumination related response of the classroom space within the interview was mentioned 56 times (both positively and negatively) involving adequate lighting, glare and daylight.

Noise - Acoustics

The acoustic quality of most of the rooms was within acceptable standards and teachers responded positively to their interim classroom environments (see Table 7 and Appendix D for acoustical reading results). However, it was noted during the observations and the interviews that opening doors and windows to allow fresh air into rooms resulted in unwanted noise from corridors and the exterior which forced teachers to make a choice between warm stuffy quiet rooms or freshly ventilated noisy ones.

TABLE 7. Responses* about Current Classroom Noise - Acoustics

Likert Scale	Noise Isolation	Speak Normally	Hear Normally
1	4	0	2
2	4	1	4
3	3	3	3
4	11	14	14
5	4	8	3
Median	4	4	4
Mode	4	4	4

*Subject responses n = 26 (5 teachers did not respond to the questionnaire)

Note: 1 = Very dissatisfied 2 = Moderately dissatisfied 3 = Neutral feeling 4 = Moderately satisfied 5 = Very satisfied

Responses from teachers within the survey indicated their satisfaction with the acoustic qualities of their rooms. Sound related issues were only discussed 26 times in the interviews usually about negative, interruption issues such announcements and outside noise when windows were open.

Temperature - Ventilation

Responses from subject teachers regarding their temperature comfort was

understandably mixed given their varied environments and the various climatic directions that classrooms faced (see Table 8).

One problem with some of the rooms was the lack of ability to ventilate or adjust the temperature within them. Consequently, it was observed that a few of the teachers in south facing rooms brought in electric fans for cooling and ventilation during the warm spring and summer afternoons. Each permanent classroom was heated with a hot water loop from a central boiler and distributed by a fan coil radiator with no individual temperature control. The fans were fairly quiet and within State acoustical standards (see Appendix D). The questionnaire data reveals that most negative reactions to the classroom temperature - ventilation measure category were from teachers with south facing rooms (68.2% unsatisfied combined response answers, 11.4% satisfied) and the most positive were from teachers in portables with individual temperature control with cooling (35.0% unsatisfied combined response answers, 65.0% satisfied).

TABLE 8. Responses* about Current Classroom Temperature & Ventilation

Likert Scale	Temperature Comfort	Adequate Ventilation	Ability to Adjust
1	3	5	7
2	5	3	6
3	5	6	2
4	8	9	7
5	5	3	4
Median	3.5	3	2.5
Mode	4	4	4

*Subject responses n = 26 (5 teachers did not respond to the questionnaire)

Note: 1 = Very dissatisfied 2 = Moderately dissatisfied 3 = Neutral feeling 4 = Moderately satisfied 5 = Very satisfied

In response to a true-false question about the ability to control ventilation without unwanted noise, 57.7% gave negative responses. Temperature and ventilation related issues were raised 40 times in the interview responses. Measurements indicated an adequate comfort range in temperature with limited ventilation.

Finishes - Furnishings

During the interview, some teachers (4) reported that they preferred vinyl tile floors rather than carpeted ones that were in the newer portable classrooms although this was not specifically mentioned in the questionnaire. They felt it was easier to maintain and keep clean (custodial service in the district had been reduced). Most teachers who had older chalk boards covered them with paper for displays and used newly mounted marker boards.

There was no clear indication within the questionnaire of response preferences for teachers regarding either the quality of classroom finishes or the maintenance of finishes at the interim school site. Room finish related issues were only discussed 24 times (out of 743 total responses) by the participants during the interview. There was however an overwhelming interest in both student and teacher room furnishings in the interview as it was mentioned or discussed 115 times and was the second highest response issue, with classroom DPE area being the most discussed topic.

TABLE 9. Responses* about Current Classroom Finishes - Furnishings

Likert Scale	Quality of Finishes	Maintenance of Finishes
1	4	4
2	6	4
3	5	7
4	7	8
5	4	3
Median	3	4
Mode	3	4

*Subject responses n = 26 (5 teachers did not respond to the questionnaire)

Note: 1 = Very dissatisfied 2 = Moderately dissatisfied 3 = Neutral feeling 4 = Moderately satisfied 5 = Very satisfied

In a true-false response in the questionnaire, 77% of the teachers indicated that their classroom furniture was capable of being rearranged for classroom activities. This is remarkable as 4 of the 6 teachers who indicated that their furniture was not capable of

being moved were teachers whose rooms limited their arrangement flexibility because of fixed counters and cabinets. As mentioned before, the two remaining teachers who responded negatively were in the smallest "unusual" subdivided rooms.

Teaching Tools - Communication

The sixth measure protocol covers a wide range of tools and devices including electrical and data outlets, display devices and more general teacher needs including copy machines and private work spaces. Similar to responses regarding temperature and ventilation questions there were mixed responses to these questions as well. The first two questions had positive responses (73% indicated moderately or very satisfied with electrical outlets and 54% were moderately or very satisfied with data and cable ports) but teachers had an opposite response to classroom display areas (54% were moderately or very unsatisfied). Responses to the question about reasonable access to teaching needs was mixed (See Table 10).

TABLE 10. Responses* about Current Teaching Tools - Communication

Likert Scale	Adequate Outlets	Adequate Ports	Adequate Display Areas	Access to Teacher needs
1	3	3	4	5
2	4	3	10	6
3	0	6	2	5
4	8	7	5	5
5	11	7	5	5
Median	4	4	2	3
Mode	5	5	2	2

*Subject responses n = 26 (5 teachers did not respond to the questionnaire)

Note: 1 = Very dissatisfied 2 = Moderately dissatisfied 3 = Neutral feeling 4 = Moderately satisfied 5 = Very satisfied

There were 104 interview responses from subject teachers regarding teacher tools with 75 (72%) of them relating to student computer equipment. When asked to compare their current teaching tools - communication with last year's, most teachers were happy with the electrical and data outlets as their previous rooms at the original school site had

little access to modern infrastructure. Their interim rooms were upgraded and properly outfitted with adequate outlets the summer before they arrived.

Access to teacher tools and supplies outside of the classroom was arduous at the interim site because of the sprawling layout and 75% of the interview responses indicated that interaction with the administrative staff was also because the office was not centrally located. The lounge was very small, dominated by a few teachers, and uncomfortable because it was adjacent to a noisy workroom. Hard, straight surfaces in corridors reflected a great deal of noise and were felt by many teachers to be unwelcome for both staff and students. However, not all of the teachers desired interaction with others. One teacher felt the that the interim school layout was better than the previous school site because he was more centrally located to the administration and could still shut his room off from his peers (compared to the previous year) and another teacher preferred the isolation (from all others).

Teacher Priorities

Teachers top priorities by far in both the questionnaires and interviews were an adequate amount of space within their classroom DPE for student furniture arrangements. Other concerns discussed within the interview included teaching equipment (usually having enough student computers) and adequate or controllable illumination.

TABLE 11. Responses* about Most Important Classroom Quality (forced choice)

Size & Layout	Light & Glare	Noise & Acoustics	Temperature & Ventilation	Finishes & Furnishings	Tools & Communication
15	3	1	3	1	3

*Subject responses n = 26 (5 teachers did not respond to the questionnaire)

A significant amount (15 of the 26 teachers who responded, or 57.7%), felt that, that the size - layout measure was the most important classroom quality in the questionnaire (see Table 11). The next highest measures chosen (at 3 responses each) were light - glare, temperature - ventilation and tools - communication. One teacher each chose the measures of noise - acoustics and furnishings - finishes.

Summary of Data

In summary, the teachers that tock part in this study were adequately experienced (over 75% had more than 6 years of teaching) and represented all of the curriculum teaching areas offered at the subject school. Most of the teachers resided in the commonly defined types of DPE at the interim site and three taught in unusual spaces. Teachers were generally content with the physical characteristics as defined in the six measures described in Chapter 1 as most of the rooms were an improvement over the DPE either at the original school site or the classroom space in which they had taught the previous year. Criticisms of the interim school classrooms included the inability to control ventilation and temperature especially on warmer days in rooms facing south, lack of control of some light fixtures (for presentations or note taking) and poor social interactive environment for both teachers and students.

Through direct observations, it was apparent how some teachers were coping within or adapting to their DPE spaces. Approximately 1/3 of the teachers had highly personalized their classrooms and created an atmosphere or character that was unique for their own teaching (see Figure 6). This mediation was measured by counting the number of "things" within the room and on the walls including posters, artifacts, non standard furniture, equipment, plants and state of daylight control (purposeful or not).

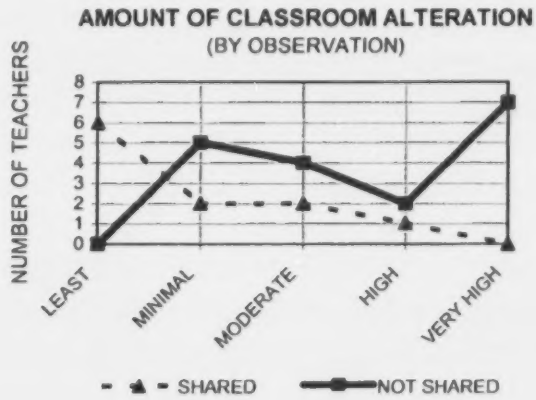

FIGURE 6. Amount of Classroom Alteration by Teachers

Teachers n = 29 (2 teachers were substitutes with no classrooms)

A common thread that tied these unique adapted environments together was the area of specialization that was taught. Most of these DPE spaces (8 of 10) involved the teaching of language or social studies. When asked about the personalization of their rooms teachers often spoke of upcoming projects or creating an atmosphere conducive to the teaching. Six of the seven teachers who were in the "very high" alteration category were female. Room adaptations appeared to be done in the spirit of the subject teachers' work plans (1-world language, 3-language arts, 1-business and 2-social studies). Conversely of the rooms that were not or slightly altered, 8 were shared between two or more subject teachers. In some cases these teachers were from different departments or teaching areas and it was therefore difficult to have a common theme for their alterations.

A few teachers were involved in the conversion of their spaces into laboratories over the previous summer but did not necessarily alter the image or character of the space beyond the layout of necessary functional portions. Many of the science teachers were positive about their interim layouts and it was assumed that this was because some had given some input direction in their DPE remodels.

On the other hand it was noted during interviews that several teachers had not yet unpacked their moving boxes admittedly because of their dislike of or lack of room within their new environments. These were usually among those who did little to change their DPE although they did have some input in their of the interim school.

Another observation that may explain the lack of adaptation or the need for visual related teaching materials (including marker and tack boards) within the room, was the use of technological tools during instruction. During interviews at the interim school, there was an admission by teachers of a greater reliance upon a screen and projection equipment to support the ongoing instruction in at least 1/3 of the rooms. These varied between overhead projectors, computer projected images and TV-VCR equipment. The observation time was relatively short compared to the instructional year and confirmation during interviews of this increasing use supported this conclusion.

By observation it also was noted that teachers used a variety of strategies within their designed physical environments to achieve a sense of health and well being

(physical comfort). Besides electric fans to ease the lack of ventilation, many adjusted the blinds to lower light levels, listened to music, locked doors for privacy during preparation periods, brought in more casual furniture and personal items such as photographs of family, plants, appliances for coffee and microwaves for food preparation which all added to what one teacher labeled a "non institutional" feel of the DPE which elevated their sense of well being. One teacher who occupied one of the small unusual spaces reported during the interview that the compact size of her classroom DPE and lack of good ventilation was the root cause of ill health among herself and her students.

In observations and follow up interviews it was noted that the most common adaptation of the classroom to teacher project goals was the arrangement of furnishings within the space so that students could respond to prepared lesson plans or separated for control. Most teachers were happy with the larger rooms so that desks and tables could be rearranged if necessary. A few rooms were either too small or had fixed equipment so that rearrangements were not possible.

In some interviews teachers reported that educational grants allowed them more computers which were generally placed at the perimeter walls because of outlet locations. It was observed that some of the science rooms had overhead outlets that allowed more flexibility in desk arrangements. Extension cords and telephone lines allowed equipment to be placed in more convenient locations when necessary. Poor light control (one switch turned on the entire room except at the portables) switching was overcome as reported in an interview by removing lamps at overhead projector screens. Extra display material covered bare walls or older chalk boards to augment lesson plans and display student work.

Several teachers voiced complaints during interviews regarding the other categories (noise, temperature, glare, etc.) as well as praise for the more positive aspects (natural light, more room, better technical access, etc.) of the interim DPE. Some also mentioned their preference for the historic characterization of the original DPE they worked in last year. Because of their recent move and regular discussions about the

remodeled school, the teachers who participated in this study seemed more aware of their past and present teaching environments than most.

A strong negative response was given about the interim school character in the interview by most of the subject teachers (83%). Complaints included the feeling of isolation and non communication with those who were friends as well as departmental peers, lack of interaction within the faculty lounge because of its proximity and size, distance to central services and administration and regimented (institutional building character and size) layout of the overall school.

Teachers were also not happy (questionnaire 53.8% unsatisfied combined response answers vs. 38.5% satisfied) with the amount of tack or pin up space because it was restricted to a few panels within each room except in portable classrooms which had ample tack board space. About half (45%) of the teachers overcame this restriction by simply taping up material on the plastered walls.

Positive teacher reports of the school that were supported by physical measurements included the qualities of illumination and acoustics within the rooms. Electrical and data outlets were ample (a major complaint from the pilot study at the original site overcome at the interim site) and the room size was admittedly adequate by most for "passive" (individual or lecture) student activities. Teachers had fairly neutral (except where noted before) responses in the categories dealing with temperature & ventilation, quality of finishes & furnishings and tools & communications.

However, the most important quality by far, was classroom size-layout. When asked if the furniture in their rooms was capable of being rearranged for their classroom activities, an overwhelming 76.9% answered that it was (except for some laboratory and smaller spaces) and they revealed that they did rearrange their furniture regularly.

CHAPTER 5 – DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

Chapter 5 begins with a discussion of the results of this study through a review of the research questions, followed by a discussion of a reconceptualization of the original theoretical framework. Revised results are then reviewed followed by the study's limitations, approach, conclusions, final recommendations and next steps.

Original Research Questions

1. In what ways do teachers change or rearrange their individual designed physical environments so that they may have a sense of well-being (i.e., feel healthy and focused?)
2. In what ways do teachers adapt their behavior within individual designed physical environments so that they may have a sense of well being (i.e., feel healthy and focused?)

The first two questions were originally posed to determine whether teachers altered or adapted to their DPE as filtered through the six protocol measures. Results of the data were reviewed with the first measure involving the size - layout through a perceived sense of crowding (Shiffenbauer, Brown, Perry, Shulack & Zanzola, 1977), a lack of privacy (Newell, 1994) or perhaps a thwarted feeling within a non functional space that prevented them from working in a desired manner (Zimring, 1981) while involved in planned activities. It was clear that some teachers (32.3% high and very high adaptation) did change or rearrange their classrooms to meet their needs while others reportedly changed their routines as noted in interviews due to lack of space for planned activities to fit within their DPE. Most teachers reported that they were happy (65%) with their larger classroom spaces for passive activities and also felt that they were able to rearrange furniture for planned activities (68%) but were somewhat negative (58%) about their room's special activity space capabilities.

Teachers responded positively (65%) to the quality of illumination and the ability to control glare (with window blinds) in the second protocol (illumination - glare) measurement but were unhappy (58%) with the inability to control the amount of light

and location. This result is supported by the literature data (Becker, 1991 as cited Veitch & Gifford, 1996). Interview responses also confirmed the desire for natural illumination for many of the teachers. Teachers perceived that some aspects of this protocol were within their control (glare or adjustment of natural illumination) but had to adapt to the space for interior lighting requirements (either on or off) such as ones that were near overhead screen locations.

Responses to the third protocol, quality of noise - acoustics within the classroom DPE for most teachers were not an issue. Physical measurements revealed a good acoustical environment except when doors or windows were opened to allow ventilation through the space. Teachers responded favorably (see Table 7, Chapter 4) to this protocol measurement and were able to alter the room devices (doors and windows) if necessary unless their need for ventilation was great, in which case they expected to hear annoying (Kjellberg, Landström, Tesarz, Söderberg & Akerlund, 1996) hallway and outside noise. Those teachers in portable classrooms were less likely to be bothered by outside noises because of their ability to control the temperature within the rooms on warmer days.

As discussed in Chapter 4, the 4th protocol measurement of temperature - ventilation had mixed responses depending specific classroom configurations and room climatic orientation. Some teachers did alter their environments with the introduction of electric fans and others simply opened windows and doors to mitigate uncomfortable conditions within the rooms. Teachers within portable classrooms had the most control and those in south facing classrooms were the unhappiest with their rooms and may have been uncomfortable when unable to control the temperature (Glass & Singer, 1972, Evans & Cohen, 1987 as cited by Evans & McCoy).

The fifth protocol regarding finishes & furnishing was interesting as teachers gave no clear indication of their preferences and so were divided in their responses to room finishes but felt strongly (77%) that they had the ability to rearrange the furnishing within the classroom DPE. There was some response to the aesthetics of the interim overall

school environment within the interview but most discussions centered around the arrangement of rooms to meet pedagogical needs.

Responses to the last protocol, teaching tools & communication, involved both interior classroom qualities and overall school qualities. Improvements to the interim spaces gave teachers the flexibility they needed to move equipment around the classroom when and where needed to support planned activities. This issue is mentioned in the literature review (Savenye, Davidson & Orr, 1991, 1992; Sanders & Stone, 1986; Canning, 1989 as cited by Davidson & Ritchie). A negative response (54%) regarding display areas was recorded although overcome by some teachers by taping materials to plaster walls. The last question in the protocol regarding teaching tools may have been too vague as it covered a variety of issues from copy machines to privacy and therefore responses on the questionnaire were understandably split. Interview responses revealed a strong teacher concern for adequate social spaces within the school.

The third research question dealt with teacher interactions with others at the entire school that was generally discussed within the 9th question of the clinical interview.

3. What are teachers' perceptions of the overall designed physical environment's social or cultural value (both within and without the classroom) with respect to accomplishing their teaching goals?

Most teachers (71%) were unhappy with the present social space (faculty lounge) and 81% did not like the layout of the interim school. They were unhappy with the both the isolation of classrooms and distance to administration and other services. At least 33% of the teachers mentioned the longing for a positive "culture" at the school in response to interview queries about desirable school and classroom qualities that would support the accomplishment of their teaching goals. Seven teachers mentioned "building character" as being important referring to the historic qualities of the original site as compared to the interim site. This relates in the literature to references to teacher needs which are beyond physical needs or labeled as "immaterial, the spiritual and affective" concerns (Uline, 2000).

What was most surprising was strong teacher responses to the last research question that forced them to choose what was the most critical quality of the 6 protocol measures.

4. What features or characteristics of designed physical environments do teachers perceive and identify as most important?

The first protocol measure of size - layout was most important to teachers. The answer to this question was surprising because it was thought that other protocols may impinge on or support teacher activities or cause discomfort more than the size and layout of the classroom based on the literature review and personal observations during school design studies. Strong agreement among so many teachers (15) was interesting given the generally positive response to their interim classroom spaces. Responses within the interviews confirmed that teachers' desire for adequate space was by followed by the need to rearrange student furnishing for planned activities even though the interim classrooms were somewhat (12%) larger then most of the teachers' previous spaces.

A Reconceptualization of the Theoretical Basis

An analysis of the teachers' responses in this study did not correspond to early expectations based on prior experience. Initially, it was thought that teachers would have had stronger reactions to protocol measures such as noise or temperature extremes that caused either discomfort or thwarted their efforts within the classroom DPE. Since many of the teachers were generally concerned with the arrangement of their space to accommodate activities with student furnishings, it became evident that there was more to their responses than simple human sensory interaction with physical stimuli of the DPE. Teachers primarily responded within this study to issues dealing with their work plans or project goals, due in part to the focus of the questions that were put to them and also because the study took place within the environment in which they practice their project goals.

Because it was thought that the initial framework may be too narrow of a lens in which to view teacher responses, a further review of current environmental behavior and

architectural theory literature was undertaken in the hope of reconstructing a new framework. This reconceptualized theoretical framework includes the initial six protocol measures and socialization concerns that were derived from the pilot study. This new theoretical construction provides a place for feedback about the physical stimuli as well as teacher work plans or project goals and symbolic social-cultural domains.

Further Literature Review

A pivotal article that that provided a means of reinterpreting this study was written by Saegert & Winkel (1990)in the Annual Review of Psychology. The authors synthesized various theories within the field of environmental psychology and concluded that these studies lead to practical and theoretical concerns that ultimately benefit us all. They summarized their findings into three "substantive paradigms" or categories within which they feel most environmental-person research studies fit. They labeled them "adaptation, opportunity structures and sociocultural forces." A fourth category entitled "Historical synthesis" which involves the remaining studies in a historical context and form "preconditions for individual and group action" (Saegert & Winkel, 1990).

The physical realm within which many of the six measures in this study are defined may also be described as the "environmental" domain, which involves the ways in which people relate to the environment itself. Teacher work plans or project goals may be thought of as the "personality or intrapsychic" domain that reflects how people relate to themselves within the environment and lastly, the Symbolic is similar to the "social or interpersonal" domain that encompasses traits that characterize how people interact with one another (Craik & Zube, 1976).

The physical domain may also be termed *adaptation* which involves the recognition of the "adaptive significance of perceptual and cognitive processes" and focuses on the interaction of the physical environment and the person as a biological being. The outcomes of this paradigm involve "health, well-being and capacities to accomplish goals". The second category, project goals, can also be described as *opportunity structures*, which consist of behavioral actions of people within the physical

environment. Saegert & Winkel state that theories within this paradigm see the environment as a "texture" of opportunity structures for "projects" involving space and time. The term "projects" means goal oriented behavior directed toward accomplishing a series of goals (Pred, 1981 as cited by Saegert & Winkel, 1990). The third category or paradigm involved in environment-person relationships, *sociocultural*, describes the "person as a social agent [that] seeks and creates meaning in the environment" (p. 457). The contrast of this category with the other two, involves meanings and actions within the environment that are greater than the individual needs.

This additional review of the literature may be summarized into three general categories or domains: physical, goal oriented and symbolic interactions (Saegert & Winkel, 1990) within the physical environment. The first category deals with human interactions using the physical senses and the attempts users make to create or adapt to a space to achieve a level of well-being and comfort. The second category focuses on teachers' defined purposes or project goals that often take place within their teaching space. Aside from maintaining human comfort, they have internal and external motivations to achieve a certain level of success. If a level of human comfort is not achieved, it may be more difficult for them to think about project goals. At times, there can be no clear separation between teachers' perceptions of what is appropriate classroom space for their well-being, project goals and the symbolic implications of its character based on social and cultural norms. The third category deals with the symbolic nature of the designed physical environments based upon social and cultural values that are perceived as helpful or hindered by the environment.

The three domain definitions redefined within this study also draw from several architectural construct theories regarding the "primary experience of buildings" including descriptions of "function, form and space" qualities involving user interaction within the environment. The "spatial" quality is that which is perceived when entering and moving through the building. This quality involves sensory or physical perception. The "functional" qualities are described and prescribed by language, which has meaning and

value beyond mere words. The "form" of a building can be described in stylistic or historic terms but these definitions break down when describing individual parts of a building. These terms are of little help when attempting to discover the social, philosophical or scientific basis for design (Markus, 1987).

Another parallel architecture theory that defines multiple domain approaches suggests that buildings give order to certain aspects of our environment. It does this through physiological control of the elements (light, air, noise, etc.), the layout of structural elements for a specific functional and social activities and the representation of beauty in cultural values (Norberg-Shultz, 1965).

Teachers' reactions to their environment may also have a cumulative effect on school culture & structure and perhaps bear a distinct influence they may have upon individual classrooms as suggested by Saegert & Winkel (1990) in what they label a "historical synthesis" category.

Zimring (1981) writes that the fit between the person and the physical environment is affected by the characteristics of the individual and the design of the environment (p. 146). Because teacher perceptions involve personal-internal processes, there are no distinct boundaries or precise domains within which these may always fit. For the purposes of this study, the three domains or lens through which the data responses may be viewed are further described in the following paragraphs.

Physical Domain Descriptions

Issues of crowding and perhaps privacy relate to the physical domain. Issues of "room enough" to accomplish day-to-day tasks may relate more to the next category or project goal domain. The amount of illumination and glare within a teaching space will affect both teachers' well being and the accomplishment of their project goals. Temperature extremes, like noise, may have an effect within the first two domains defined in this study. There appears to be some symbolism based on social-cultural "style" or "character" as well. Room finishes and furnishings may be important components of teacher project goals and social-culturally symbolic of appropriate

educational spaces. Although access to and use of teaching tools appear to relate best to teacher project goals, the lack of these items may affect their well-being. Inability to connect and communicate with others may also affect social-cultural relationships, which, appears to symbolically affect teacher status in the community (Tuettemann & Punch, 1992).

Project Goal Domain Descriptions

If classroom spaces were adequate for teachers' needs, then logically they would be more objective in their perceptions of what was important to them regarding their project goals. The fact that many of the individual classrooms were larger, better heated, wired and illuminated than many of the teachers' prior classrooms, supported the notion that these teachers were not influenced by blatant problems (except in cases noted) that might otherwise skew more objective responses. Because of the contrast between the original (historic) site and the interim (modern style) school site, the continued discussions among many of the teachers regarding their current and future needs and the tentative time frame (2 years), it was felt that a higher awareness of the physical environment regarding teacher project goals would be present.

Symbolic Domain – Social and Cultural Descriptions

Any "mismatch" between the intended space "program" for the teaching space and the current use of the space as well as poor physical conditions related to teacher well being and behavior may be attributable to an incongruence between some aspects the built form of the DPE and the social-culture aspects of the school over time. There is not always an observable "fit" between socioculture beliefs and practices and built (DPE) forms. Sociocultural changes may precede and then cause a lag in the built forms or vice versa. It is not clear how a culture and forms that represent it could harmonize if or one or the other is constantly changing. A hypothesis of "congruence" between forms and culture suggests that rates of change in cultural systems are internally consistent but are difficult to identify (Lawrence-Zuniga, 1997).

Broader Conceptual Framework

Because of the reconceptualized theoretical framework, the six protocol measures were revisited and viewed through the lenses of the newly defined general domains. It appears that some of the measures fall easily into one or more of these domains and were therefore conceptualized as either relating to either teacher goals, social-cultural ideals or physical comfort. A larger sample of teacher response may be studied to confirm the generalizability of these assumptions. The measures of noise-acoustics, temperature-ventilation and light-glare, as mandated by the state administrative code, seem to relate more to teacher (and student) health and well-being or fall within the physical domain. Size-layout and furnishing-finishes measures relate to the teacher project goals and tools-communications may relate to both project goals and symbolic social-cultural domains. There is some cross over to other domains for the light-glare and size-layout domains but these were not primary concerns of the teachers in this study. The following diagram illustrates the relationship of the 3 newly defined domains and the original 6 measures in the study (Figure 7).

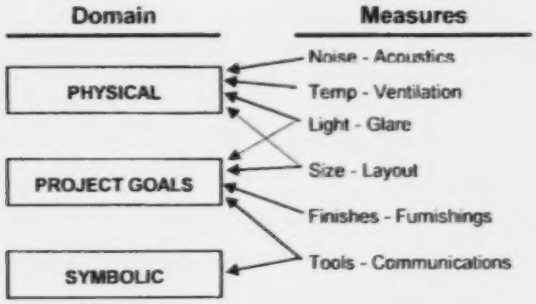

FIGURE 7. Domain and Protocol Measurement Relationship

Reconceptualized Framework Affecting Instrumentation

Instead of viewing the responses in terms of the six protocol measures, the data was reevaluated to see if it refers to adaptation opportunities or symbolic meaning. Seven questions within the interview allowed teachers the freedom to choose not only on the

basis of their project goals that dealt with cognitive but affective or inspirational ideals which asked about their "wishes" and "worst case" scenarios.

Coding of the follow-up interview was therefore broken down into the three domains (A) Physical, (B) Project Goals and (C) Symbolic Social-Cultural. Each of these three was then noted to include the six categories and sub categories within them. Teachers were given freedom in their response choices during the interview, consequently their responses widely varied. Judgments were made after the interviews as to which domain each fit within based on subject responses, whether these involved issues of stress or well-being, every day work tasks or symbolic ideals based on social or cultural concepts.

Examples of coding related to well-being or stress included answers about size that felt crowded (when not discussing project goals) or the ceiling was too low. Light that produced glare or the desire for natural light was also put into the Physical domain. If the room felt too warm or stuffy and if the noise was bothersome, these all were including in the first domain.

If teachers felt the room was not large enough for their planned activities, control of the lighting was inadequate to view the screen or take notes during presentation, or the corridor noise made listening to speech impractical, these codes fell into the second domain of Project Goals.

The Symbolic Social-Cultural Domain was more difficult to code. Descriptors were reconstructed based on responses that were coded if mentioned by at least two of the subjects teachers. These include the following numbers that are simply sequential codes after the initial six protocols measures developed in the pilot study and asked in the questionnaire. The numbers have no numeric value as some descriptors fell into more than one category. The responses numbers were also categorized into the three domains depending on a perception of teacher subject intent when answering the questions. If the answer appeared to be related to their well-being, it was put into the A - physical domain

category. If work related it was put into the B - project goals domain and if socially or culturally related it fell within the C-symbolic social-cultural domain category.

1=size; 2=illumination; 3=noise; 4=temperature / ventilation; 5= furniture / finishes; 6=tools; 7=classroom sharing; 8=faculty interaction/gathering; 9=student gathering area; 10=central services; 11=building character; 12=building size; 13=prep space; 14=feeling-culture of place; 15=no change; 16=safety/security and 17=time

The symbolic social-cultural domain issues of school culture, classroom sharing teacher social interaction and school size were of higher concerns within interviews than those dealing with well-being (see coding results in Appendix C). The observations supported an inverse relationship between high personalization and sharing of the classrooms. There were also gender and age implications in these results but the overall numbers of teachers within this study were too few to make any generalizations.

Response Data Reevaluated

When asked in the interviews about changes to the DPE to have it be more effective, most teachers (94%) responded in terms of their project goals. The remaining responses dealt with their physical well-being and symbolic domain issues. The physical domain included 9 responses that spoke of irritation or disruptions to project goals that may have caused stress. These included temperature discomforts (4), noise interruptions (3) and glare (2). These results were consistent with prior questionnaire responses.

The highest concern with physical domain type responses within the interview dealt with DPE illumination and its control. This was supported by the questionnaire responses as well. Glare was perceived as a negative type reaction and natural light as a positive one. Ironically they are supplied by the same means (the exterior wall windows and a few skylights) and therefore the issue really became one of control (blinds or shades). Most teachers appeared to be happy with their new (dark blue) blinds although lighter ones would have reduced heat gain on the southern exposure windows. Measurements of illumination of several typical classrooms showed higher potential glare levels on the northern facing rooms due to lack of shade and foliage on these sides.

Physical Domain

A comparison of responses from the two polar subject teacher groups, those who either did little or nothing to alter their environments and those who had highly personalized their environments suggested a strong relationship to the classroom size category and whether or not these teachers shared their space. The teachers with their materials in boxes complained of lack of space although two of these teachers had made some effort to adapt to their space. All of the teachers who did little or nothing to adapt their space shared it with another teacher. There was a strong negative (68%) reaction to future sharing concerns in the remodeled school. Many who personalized their rooms said that they were seeking out others with similar tastes to be their future sharing partners.

Only one of the teachers complained of ill health because of their classroom space. This was due to a perceived lack of ventilation and close proximity to others in their smaller classroom that was one of the original rooms subdivided to create more classrooms. Other individual negative (stress related) concerns included perceived lack of space due to quantities of furnishings, inability to control temperature and lighting, institutional quality of finishes and noise interruptions from exterior and announcements. Two teachers complained of safety concerns within their laboratory spaces. The temporary or interim nature of their rooms, either because of cost constraints or lack of time, caused some visual impairment so that they could not adequately see all of their students that may be in potentially hazardous situations. Other complaints of visual or aesthetic nature included the presence of necessary piping and ducting for fire and ventilation requirements. Even though these utilities were necessary, the teachers felt that they were unsightly in a classroom environment.

Project Goal Domain

Several (female) teachers highly adapted their rooms to be congruent with their lesson (project goal) plans. These rooms appeared to reflect their pedagogy as well as their personalities. The rooms felt different, less cold and institutional. Some teachers also were concerned about having enough natural light and also used their blinds to

reduce glare. When questioned about changes to their routines teachers most often mentioned furniture within the room as the cause or remedy for the change. All of the teachers who highly personalized their classrooms were satisfied with the amount of room although some would have liked more. This response was also dependent upon the amount of classroom space. One teacher also included the ceiling in their modification (attaching quotes and sayings to ceiling panels) and when asked why, this person responded that every place in the room had a teaching "moment" no matter where the student looked. Another teacher brought in models and sculptures of various types and clearly modified their space. This teacher also used furniture arrangements to isolate or encourage discussions among students. It should be noted that many teachers did not limit lessons to the classroom, but used the library and grounds to accomplish their goals. One teacher in particular felt that the school and classroom "institutional" qualities were reflective of our societal attitude toward education. This teacher felt that richer colors and furnishings would greatly aid in a more conducive learning environment and in fact stated that they had done so in another school. As previously noted (see Figure 6.), there was an even split between those teachers who adapted the spaces and those that adapted to their spaces.

Symbolic Social Cultural Domain

During the pilot study, teachers were asked if they thought it important to collaborate with other teachers in promoting student academic progress. Most agreed but noted several issues that prevented them from doing so. The interim school design allowed fewer opportunities for interaction because of the lounge size and location (the interim site was originally designed as junior high school). Consequently most responded negatively to this worsened condition. Many reported feelings of isolation even within their own expertise or department of study. A younger teacher felt that more technological interaction was needed in the school. Teachers had not yet been given the ability to communicate with one another on e-mail and so communicated less then they would have liked. Some were discouraged because of the distance to the faculty lounge,

others because of its size, its combination with the workroom (noisy) and ownership by one gender (male). It appeared that they felt good about having adequate voluntary interaction (lounge and student commons) spaces but negative about involuntary interactions (sharing). On the subject site several teachers sought out those with whom they could be compatible so that they could better mediate their teaching environments to support student-learning achievement. The fact that most of the highly personalized rooms were female teachers and that younger teachers occupied most of the shared spaces that were not personalized should be further studied.

There was some appreciation of the character and compact nature of the original historic school site and a quite negative reaction to straight hallways that did not allow for congregations at key intersections where students tended to impede movement for others. The interim school's focus was on individual classrooms and not an overall interactive culture.

Further Discussion

There appears to be documented evidence of the effects of physical environmental conditions within schools upon student achievement when narrowly measured through aptitude and achievement testing (McGuffey, 1982). It is also apparent that teachers' actions within their classrooms affect student achievement (Croninger & Lee, 2001) in similar ways as they interpret school district restructuring (Olsen & Kirtman, 2002) and other reforms including multicultural integration (Grant & Wieczorek, 2000) and. technological tool implementation (Salomon & Almog, 1998).

Since classroom teachers have societal responsibility for student academic progress as noted in the subject's state requirements labeled "teacher responsibilities" (WAC 180-44-010, 1991), intuitively it follows that teacher perceptions of and responses to their designed physical environments (DPE) are important to consider since it is teachers who prepare students and sometimes administer these all important test measurement indicators.

Through questionnaires, observations and interviews, this study revealed the degree to which 31 teachers altered their classroom spaces or changed their routines to meet their pedagogical needs. In a preceding pilot study with many of the same subjects, virtually every teacher admitted their active role in their students' learning (Lang, 1999).

As previously noted, three teacher perceptive domains were defined as theoretical constructs within which teacher responses were placed. The physical, project goal and symbolic social-cultural domains are based upon a summary overview of current environmental behavior research studies (Saegert & Winkel, 1990) and seem appropriate classifications within which to place teacher responses within this study. Either by design or by nature, when asked about their critical concerns, most teacher responses fell within the project goal domain. This seems logical as most questions related to their accomplishments within their work environments.

Limitations

This study was limited to an "exploratory" case study involving 31 secondary teachers on an interim school site. It was conducted in a "snap shot" of time, observing and interviewing each teacher only once. There are however, salient aspects of the study that might be applicable to other high school teachers when dealing with issues of adequate, flexible space for classroom activities, control of illumination and interaction with peers. The circumstances under which these teachers were questioned, that of practicing within a temporary teaching space (for two years), allowed a higher level of awareness of their physical setting than if they had been entrenched in a permanent setting for a number of years.

Participation and subject answers were entirely voluntary and although supported through observations and physical measurements, were limited to self-professed perceptions. Every variable within a messy school field environment is difficult to define and control. To counter many potential variable influences such as classroom group dynamics, curriculum changes, individual teaching styles, school schedule or time constraints and parent pressure for student progress, a broad selection of subject teachers

that represented the entire school staff were questioned toward the end of the school year. For this group of teachers at this time of year, it is possible that felt many of these other variables were diminished in the thoughts of these teachers.

Approach Reassessment

The approach of exploring teacher mediations to their interior school spaces and how these mediations may ultimately affect student academic achievement was a vital part of this study. It was also important to measure whether teacher responses were physically, project oriented or symbolically based so that empirical data gathered can help define architectural theories and suggest how classroom designs may be improved. Behavioral theory data can help to inform architectural theories that prescribe solutions for future designs (Moore, 1997). Perceived qualities of physical spaces together with apparent personalized alterations have design and layout implications for future educational environments, at least within this subject district if this school is representative of the district.

All three defined domains (physical, project goals and symbolic) appeared to be iterative with one another. Teachers with perceived poor physical conditions within their DPE seemed thwarted from accomplishing their project goals. Several had yet to unpack some of their moving boxes after eight and nine months into the school year indicating that there was some apprehension, frustration or at least not a strong desire to mediate their classrooms. Teachers said that some of these perceptions were based on comparisons of their classrooms from the prior year at the original school site.

There were no judgments or apparent indications of lack of accomplishment with respect to student academic achievement for these teachers, just an indication of a lack of motivation with respect to personalizing their rooms. Many of those who did not change the appearance of their rooms also felt no ownership because of involuntary sharing due to lack of overall classroom spaces. This may have affected their sense of well-being and in a symbolic sense that they felt unappreciated (Tuettemann and Punch, 1992). However, there were a number of teachers who did moderate rooms, and the evidence of their effort

and personalization was compelling. Teacher moderation efforts included personalization (objects and effects) and day-to-day alterations of furniture arrangements, lighting and sound control. Temperature control was problematic. Those who did not moderate their rooms because of perceived poor qualities also indicated some degree of irritation that may have affected their well-being. The lack of voluntary social interaction spaces at the interim school may also have affected teachers' sense of comfort as many indicated a strong displeasure with the existing layout and location.

Conclusions

Although the interim school classrooms, as described in Chapter 1, were larger than what the subject teachers had previously experienced, most still felt that the size and layout of a classroom was more critical to their teaching experience than the other categories of light & view, noise & acoustics, temperature & ventilation, furnishings & finishes and tools & communications except when there was an extreme problem. This appeared to relate to teacher project goals (freedom to change arrangements) rather than physical well-being (feeling crowded or needing privacy).

The strongest responses from subject teachers revealed a significant desire to have enough space within their rooms to rearrange student furniture for planned activities, control the location and amount of lighting and have access to adequate amounts of computer tools for their students. Mediation of classroom spaces was associated more with individual teaching goals rather than basic physical needs, although there was evidence that accommodating teacher well-being was important.

This study disclosed teacher desires for opportunities for interaction with peers and an equally negative response to sharing teaching spaces with those with dissimilar styles of pedagogy. At first this may seem contradictory, but the two responses involve positive social-cultural interactions when teachers are not directly involved in the act of teaching (project goals), and perceived interference during their teaching. Complaints by teachers of involuntary sharing of DPE involved issues of security, cleanliness and changed furniture arrangements. Teachers anticipated sharing future spaces and began to

search for those with similar tastes and aspirations. Desires for voluntary interaction in the form of a teacher lounge were limited in this school by a decentralized location (too far), size (too small) and noise (adjacent to work room).

One issue that appears to compound the need for adequate classroom space is the introduction of technology tools for student lesson plans. A traditional classroom size (800 to 1000 SF) is generally large enough to accommodate the arrangement and rearrangement of student and teacher furniture, some storage and equipment space. With the addition of computer tools there comes the problem of wiring and placement of these tools, which limits the ability to rearrange furniture. In the subject classrooms most teachers moved their computer stations to the perimeter walls, which allowed some flexibility within the center of the room but reduced the overall area. With this addition of computer tools (which many teachers ranked as a 3rd highest need), comes a restriction of their two highest needs: adequate space and movable student furnishings. The advent of newer wireless network systems and flexible (movable) laptop computers may resolve this dilemma.

Therefore it is concluded that a majority of teachers indicated that either altering their pedagogy or physical space usually involved activities within their project goals domain. Their primary significant response involved enough teaching space to arrange student furnishings to accomplish their goals even though they were fairly satisfied with their present environment in many respects. Other than less control over electric illumination, most teachers felt better off than before in every regard except with the layout of the interim school which was felt to be "spread out" and "isolating."

Practically speaking, this group of teachers was more aware of their designed physical environments then most because of their current situation at the historic and interim school sites. The act of picking up their teaching materials and relocating to a new school site was bound to change their outlook. Many were regularly briefed about future arrangements and the impact this may have on their new spaces. Their new interim classroom spaces were a marked improvement in contrast to their older spaces although

the overall school was lacking character. Consequently teachers did have a deeper contemplation of their teaching space needs and were able to reflect and better articulate what was most important to them.

Recommendations

Although this study cannot be widely generalized, there is evidence from this study to support the idea that architectural guidelines for school design should include critical examinations of individual teachers' articulation of project work plans and goals at specific school sites. A deeper collaboration between teachers and designers should occur regarding environmental behavioral effects beyond a simple discourse of space needs. This collaboration should result in a more detailed analyses or description on the part of the architect which leads to the allocation of adequate space for arrangements furnishings and equipment and a deeper awareness on the part of the teacher of their responsibility to go beyond the maintenance of their room to creating opportunities in the DPE to achieve their project goals. Individual teachers should be able to control illumination for specific teaching in their classroom DPE. Individual control of temperature, ventilation and noise also appears critical for teachers' sense of well-being (Evans & McCoy, 1998). Natural light and views to the exterior should also be considered as evident in this and other recent studies involving schools (Heschong Mahone Group, 1999). Teachers cared about the overall layout, social interaction and central services of their schools that bring meaning to their relationships. Specifically, teachers should be able to interact with one another and have access to administration, restrooms and supplies without having to travel too far.

School districts who anticipate teachers sharing classroom spaces should encourage teacher voluntary interaction prior to the move-in so that compatibility between teachers and use of space may be better ensured.

Finally, the key elements that were significant within this study included the classroom size, student furniture arrangements, illumination control for teaching activities, adequate teaching tools in the form of computers and overall school layout that

involves social-cultural interaction spaces. These characteristics may be isolated and studied further to investigate their significance for teacher mediations within the classroom DPE and evaluated against some meaningful measures of student achievement.

Next Steps

The underlying assumption of this exploratory study is that teachers' mediation of the DPE is desirable, both for the quality of the space and for learning. But how can mediation be understood and advanced within the limitations of current architectural and educational practice? The next steps that I propose can be categorized within the realms of research, practice and policy. The following paragraphs include exploratory suggestions of how these may be further pursued.

Research

An ideal first next step would be to follow these subjects or a similar group of teachers within this same school as they move back into their remodeled spaces in the following years. Longitudinal or post-occupancy evaluation studies that track teacher adaptation to and adaptation of their new classroom spaces over several years could yield rich results for future designs within the school district.

In addition, this study should be refined and administered to a larger population. The number of teachers who participated in this study (31) was too small to determine significant correlations between the six measure definitions and teacher mediation. It would be compelling however, with larger sample sizes using factor analyses, to determine if any correlation could be made and how these may parallel the three domains described and inspired by the writing of Saegert & Winkel (1991) and others. These larger sample results may have broader indications and possible implications for practice and policy decisions for future school designs. An important aspect of this study was the combination of quantitative and qualitative data. Future studies should follow this format as one data set informs the other.

Future studies could also involve parallel groups of teachers in different school settings to see if their perceptions of mediations and needs within designed physical

environments yield similar results. More importantly, expectations for the effect of teacher mediation on student performance should be set forth and tested. If a correlation can be shown between, for example: student perception of caring, increased academic achievement, fewer discipline problems, or better attendance these results could have significant impacts on practice and policy decisions, and lend support for investing in the teacher mediation process.

Practice

Currently new or remodeled schools are planned in a very linear fashion. Funding is obtained for future school space based either on characteristics of the existing facilities (i.e., lack of infrastructure or quality of space) or real needs for more teaching space because of increasing student populations. Facility planners, designers and educators then determine the scope of future facilities based on traditional or emerging teaching practices approved by district policy. Time and money typically constrain the extent of teacher-designer interaction; therefore a practical sample of teacher/administrator input is devised and utilized. The result is a space-planning document that is called an educational specification or "ed specs" for short. Architects then transform these documents into three-dimensional solutions that may be described in this study's six measures. Many of the teachers who move into new spaces have had no input as to its character or layout. They must then begin the process of mediation to these new spaces in order to meet their current project teaching goals.

It would be beneficial if the ed specs were an iterative, interactive, performance-based process rather than a "cookbook" type document. Teachers, together with architects could then collaborate on a school design that would be born of both practical and inspired ideals. Teachers would be encouraged to elaborate on their physical needs that support their project goals and architects would envision and describe how best to meet these within the framework of district budget and time related perimeters while maintaining the quality and character of the physical environment.

Another concept that may better support teacher mediation is a yearly or biannual "remodel" stipend. This could be used in concert with space planners or architects in "rethinking" educational environments to better meet current project goals. This process may even occur in collaboration with groups of teachers and students at the beginning of the school year depending on the school or group scheduling process. These and other ideas borne of this study have broad implications to district policy. Since schools are public institutions. major questions to be resolved are 1) how such an intensive, site-specific process would be financed and 2) how can such an approach avoid parochialism (for example: how can local groups adhere to best practices in sustainability, adaptability, value engineering, environmental sensitivity and others).

Policy-making

Currently, there are societal questions as to the effectiveness of many secondary school environments and how much value they have towards helping students achieve individual success. Questions that are implied as the basis of this study include: Who or what dictates district policy for school facility design? Are the real clients of school designers the administrators, teachers, students or parents? Since it is parents (of past, current or future students) within the broader community who vote to tax themselves for new buildings as well as elect school board members who then adopt and approve policy; then parents in the community should be informed of what is vital for the character of designed physical environments in which their children learn. Parents must take some responsibility in the funding of optimum learning environments as well as ensure that teachers and students are provided every opportunity for mediation to meet their current needs.

As demonstrated within this study, the physical environment is partially a reflection or adaptation of the individual using that environment. It is also a reflection of the school culture and an expression of the care of the surrounding community. Because the educational process is constantly changing to better meet the needs of students, teachers, parents and administrators, then perhaps more thought, time and funding must

be given the fabric or physical environment within which the educational experience takes place. It seems that something of high value would demand greater attention in appropriate allocations of time and thinking if it were to be most effective in its function and purpose.

Concerted efforts which work on all three fronts simultaneously (research, practice and policy-making) will improve the likelihood that public dollars will be well spent in future decision-making about investments in the building of our nation's schools.

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APPENDIX A

Consent Forms and Correspondence

University of Washington
College of Education

Consent Form for the

Teachers' Responses to the Physical Environment

Investigator:
Dale Lang, doctoral candidate, College of Education, 206.547.6239, juliejodale@msn.com

Investigator's Statement:

I am asking you to participate in a research study. The purpose of this consent form is to give you the information you will need to help you decide whether or not to be in the study. Please read the form carefully. You may ask questions about the purpose of the research, what we would ask you to do, the possible risks and befits, our rights as a volunteer, and anything else about the research or this form that is not clear. When all your questions have been answered, you can decide if you want to be in the study or not. The is process is called 'informed consent.'

PURPOSE AND BENEFITS:

This study is a research activity. The questions you answer will involve your perception of the physical characteristics of your classroom and how your response to them may affect your teaching methods or style. By obtaining feed back from you in this manner I hope to provide valuable insight to facility designers in the hope that improvement may be made for future schools that may allow you to teach more effectively. I am also conducting this study to satisfy one of the requirements for a graduate degree in Education.

PROCEDURES:

This study will begin with a brief questionnaire about your opinion of the physical characteristics of your present classroom such as, ***"Can you speak in a relaxed tone in your room and normally be heard by students?"*** I will then make an appointment with you (on Fridays or Mondays) to observe how you may respond to these physical characteristics while you are teaching within the classroom. Finally, I would like to interview you face-to-face for about an hour after school within the room. You may of course refuse to answer any question or item in the questionnaire or interview.

OTHER INFORMATION:

Any information about yourself in this study will held in strict confidence. Only I will have access to identifiable data that links you to your answers and this linkage or code list will be destroyed after the information has been analyzed and organized for my dissertation. The final writing should be complete by the end of this year. You will not be penalized or lose any benefits if you choose not to answer questions or withdraw from the study. The final report of the results of this study will be filed in the thesis section of the University of Washington Library.

_____

Dale Lang, Investigator for the Teacher Response study Date

Participant's Statement:

This study has been explained to me. I volunteer to take part in this research. I have a chance to ask questions. If I have questions about my rights as a research participant, I can cal the Human Subjects Division at 206.543.0098. I will receive a copy of this consent form.

_____

Teacher Participant Signature Date

Research, Evaluation,
and Assessment
815 Fourth Avenue North
Seattle, WA 98109
(206) 252-0143

The
Seattle Public
Schools

April 10, 2001

Dale C. Lang
909 N. 35 th Street No. 201
Seattle, WA 98103

Dear Mr. Lang

The Seattle Public Schools has completed its review of your research proposal, "Teacher Interactions within the Physical Environment: How teachers Alter their Space and/or Routines because of Classroom Character." As a result of that review we can approve your study as you have proposed in your application. We understand that the study will be conducted only at [redacted] High School. Please work closely with the principal, [redacted] and his staff as you conduct the study.

Should you have any additional questions, please contact me.

Sincerely,

Michael J. O'Connell, Ph.D.
Director

CC: [redacted]

January 26, 2001

[redacted] High School

The Seattle Public Schools

To Whom It May Concern:

Dale Lang, an architect and student at the University of Washington, proposes to conduct a study and will be observing teachers and students in their classrooms at the interim [redacted] for the next few months. He is studying ways to improve classroom design. He will interact with teachers but will not interact with any students or their learning but will be present just to observe normal classroom routine.

He has described his study to us and we understand that it involves a brief questionnaire, classroom observations and follow up interviews with teachers. Participation in the study is entirely voluntary for both teachers and students who may be observed while in the classroom. The entire study should last approximately 2 ½ months.

Mr. Lang will retain the initial list of volunteer teachers and hold it in strict confidence. It will then be destroyed when the study is complete. The final results will not contain any individual names of the respondents nor connect them to the data. Responses from volunteer subjects will be analyzed by category or group only. He has promised that confidentiality will be fully respected.

On behalf of the school, I therefore give my consent to the Teacher Response to the Physical Environment study.

Sincerely,

[redacted]

Principal

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APPENDIX B

Questionnaire, Observation Form, Interview Questions

QUESTIONNAIRE

Please circle or mark only one answer (**A, B, C,** etc.) per number. All responses are strictly **confidential** and results will be reported by groups only. Please give to when completed. Thank you.

Classroom Existing Room Characteristics

Please evaluate the **characteristics** of your current classroom space in the following areas:

SIZE & LAYOUT: *Does your classroom have…*

1. adequate **room** for teaching and student activities for **passive** (listening or individual work) activities?
   - (A) Very dissatisfied
   - (B) Moderately dissatisfied
   - (C) Neutral feeling
   - (D) Moderately satisfied
   - (E) Very satisfied

2. adequate **flexibility** for teaching and student for group or project activities?
   - (A) Very dissatisfied
   - (B) Moderately dissatisfied
   - (C) Neutral feeling
   - (D) Moderately satisfied
   - (E) Very satisfied

3. the **size** or **area** you need for any **unique** or **special** activities? (Choose closest description)
   - (A) way too small?
   - (B) a little too small?
   - (C) just the right size?
   - (D) a little too large?
   - (E) way too large?

LIGHT & GLARE: *Does your classroom have…*

4. adequate **illumination** for everyday activities?
   - (A) Very dissatisfied
   - (B) Moderately dissatisfied
   - (C) Neutral feeling
   - (D) Moderately satisfied
   - (E) Very satisfied

5. bothersome **glare** in some part of the day (shinning in your eyes from any source)?
   - (A) Very dissatisfied
   - (B) Moderately dissatisfied
   - (C) Neutral feeling
   - (D) Moderately satisfied
   - (E) Very satisfied

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6. **adjustable** or **controllable** lighting (i.e. can you switch them without help)?

(A) Yes (B) No

NOISE & ACOUSTICS: *Does your classroom…*

7. have a **quiet sound** – barriers or treatment from outside noise sources (i.e. noises from other classrooms, hallways, window-outdoors activities, heating vents, etc.)?

(A) Very dissatisfied
(B) Moderately dissatisfied
(C) Neutral feeling
(D) Moderately satisfied
(E) Very satisfied

8. allow you to **speak** in a normal or relaxed tone within the room and be normally **heard** by students?

(A) Very dissatisfied
(B) Moderately dissatisfied
(C) Neutral feeling
(D) Moderately satisfied
(E) Very satisfied

9. allow your to **hear** student voices when they **speak** in a relaxed tone during normal activities?

(A) Very dissatisfied
(B) Moderately dissatisfied
(C) Neutral feeling
(D) Moderately satisfied
(E) Very satisfied

TEMPERATURE & VENTILATION:

10. How do you feel about the **temperature** in your classroom most of the time?

(A) Very dissatisfied
(B) Moderately dissatisfied
(C) Neutral feeling
(D) Moderately satisfied
(E) Very satisfied

11. Is the classroom capable of being adequately **ventilated** (freshness vs. stale smells)?

(A) Very dissatisfied
(B) Moderately dissatisfied
(C) Neutral feeling
(D) Moderately satisfied
(E) Very satisfied

12. Can you adjust the temperature or have it adjusted to your liking?
    (A) Very dissatisfied
    (B) Moderately dissatisfied
    (C) Neutral feeling
    (D) Moderately satisfied
    (E) Very satisfied

13. Can you adequately regulate the amount of fresh air in your room without incurring bothersome outside noise or disruptions?
    (A) Yes (B) No

FINISHES & FURNISHINGS:

14. How do you feel about quality of finishes (paint, floor, ceiling, cabinets) in your room?
    (A) Very dissatisfied
    (B) Moderately dissatisfied
    (C) Neutral feeling
    (D) Moderately satisfied
    (E) Very satisfied

15. Do you think these finishes are capable of be easily cleaned or maintained to your satisfaction?
    (A) Very dissatisfied
    (B) Moderately dissatisfied
    (C) Neutral feeling
    (D) Moderately satisfied
    (E) Very satisfied

16. Is the furniture in your room capable of being rearranged for your classroom activities?
    (A) Yes (B) No

TEACHING TOOLS & COMMUNICATION:

17. Do you have adequate outlets for electric devices that you currently or would like to use?
    (A) Very dissatisfied
    (B) Moderately dissatisfied
    (C) Neutral feeling
    (D) Moderately satisfied
    (E) Very satisfied

18. How do you feel about the amount of communication ports (data/cable/telephone) in the room?
    (A) Very dissatisfied
    (B) Moderately dissatisfied
    (C) Neutral feeling
    (E) Moderately satisfied
    (F) Very satisfied

19. Do you have adequate marker board, tack board and display areas within your room?
    (A) Very dissatisfied
    (B) Moderately dissatisfied
    (C) Neutral feeling
    (D) Moderately satisfied
    (E) Very satisfied

20. Do you have reasonable access to other teaching needs such as copy machines, long term book storage, break or lounge rooms, private study or confidential conference areas?
    (A) Very dissatisfied
    (B) Moderately dissatisfied
    (C) Neutral feeling
    (D) Moderately satisfied
    (E) Very satisfied

Classroom Most Important Quality – ONE ANSWER for the next 6 questions

Given the previous 6 categories of classroom issues: *Size & Layout; Light & Glare; Noise & Acoustics; Temperature & Ventilation; Finishes & Furnishings; Tools & Communication,* please choose the **one** that you feel to which architects and facility planners must pay the most attention (**choose ONLY one**):

21. (A) Size & Layout
22. (B) Light & Glare
23. (C) Noise & Acoustics
24. (D) Temperature & Ventilation
25. (E) Finishes & Furnishings
26. (A) Teaching Tools & Communication

Thank you for your answers to my survey. The next few questions concern your personal qualities as a teacher and are submitted to you in order to establish a statistical basis for analyzing your answers. It is my hope that your answers will help provide a basis for a better model for future school design.

Personal Demographics

Please indicate the following demographic information about yourself (**confidentiality** and **privacy** ensured) so that I may group the results in a variety of ways:

27. Total years of teaching at the secondary level
    (A) Less than 5 years
    (B) 6 to 10 years
    (C) 11 to 15 years
    (D) 16 to 20 years
    (E) 21 or more

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28. Total years of teaching at West Seattle High School
    (A) Less than 5 years
    (B) 6 to 10 years
    (C) 11 to 15 years
    (D) 16 to 20 years
    (E) 21 or more

29. Total years of teaching within the Seattle School District
    (A) Less than 5 years
    (B) 6 to 10 years
    (C) 11 to 15 years
    (D) 16 to 20 years
    (E) 21 or more

30. Age in years at the end of this calendar year.
    (A) under 25
    (B) 26 to 30
    (C) 31 to 40
    (D) 41 to 50
    (E) 50 or over

31. Years (round to the nearest year) of college education as of January of this year.
    (A) None
    (B) 2 or less
    (C) 3 to 6
    (D) 7 to 10
    (E) over 10

32. Highest Degree Attained:
    (A) No Formal Degree but met requirements for my instructional area
    (B) Community college - technical school or equivalent
    (C) Bachelor or equivalent
    (D) Master or equivalent
    (E) Doctoral or equivalent

33. Please choose **ONE** of the following that best describes your **teaching** area or **specialty**:
    (A) Bilingual Education
    (B) Business
    (C) Family and Consumer Science
    (D) History
    (E) Language Arts

34. (continued if one above was not chosen – leave others blank) Teaching area or specialty:
    (A) Library Science
    (B) Math
    (C) Performing Arts
    (D) Physical Education/Health
    (E) Science

35. (continued if one above was not chosen – leave others blank) Teaching area or specialty:
    (A) Social Studies
    (B) Special Education
    (C) Technical Education
    (D) Visual Arts
    (E) World Languages

Thank you very much for your time, effort and participation!

OBSERVATION FORM - SAMPLE

Date/Time: 5.11.01/12:50 PM
Teacher/Room/Subject: No. 3 / / Algebra

SIZE & LAYOUT
Size: 30'8"Lx26'6"Wx8'0"H
Classroom Type/Orientation: **P** - Portable / **E** - door & (2) windows face east

LIGHT & GLARE
Illumination Sources: Suspended (15) 2x4 fluorescent light fixtures spaced in a regular pattern with prismatic lens plus two 4'x5' aluminum sliding windows with dark blue mini blinds that were raised up and door with 6"x3' glazing

Potential Glare: Marker boards, light lenses direct view, reflection bouncing off of light colored reading material on desks, through windows w/ direct view of overcast sky or exterior reflective surfaces on a sunny day

NOISE & ACOUSTICS
Noise Sources: Interior - continually running heat pump in the NW corner, human voices and transmitted noise via floor membrane (plywood), speaker
Exterior - transmitted noise south through wall from rooms to the north or airborne through open windows

Acoustic Treatment: Band of absorbent material at tack surface around the room alternating with marker boards, acoustical tile ceiling (suspended) and carpeted floors. Assume there is some insulation in walls.

TEMPERATURE & VENTING
HVAC: Large heat-pump unit in the corner of the room disperses tempered air and can be adjusted with a nearby thermostat. No ducts were evident.

Natural climate control: Windows and doors are operable and there is most likely thermal insulation in the roof, walls and flooring. Openings on one side of the room only (no flow through possibility). Some morning sunshine can penetrate east-facing windows and dark blinds can capture and transmit heat gain.

FINISHES & FURNISHINGS
Finish Materials: Newly finished interiors including carpet, vinyl wall with acoustical tackable areas and white fiberboard panel ceiling. Dark blue shades and carpet but medium color walls

Furnishings: Student (3 person) tables grouped like hexagons to form groups, file cabinets, teacher's desk and chair, bookcases, with scientific instruments. Two large (white) marker boards located on the south wall, portable marker/chalk board and stool

TOOLS & COMMUNICATION
Tools: An OH projector, one computer and printer
Communication: Electrical and data/comm. outlets spaced around the room, telephone near teacher desk (SE corner), clock-speaker on north wall above the tackboard surface, long chord to overhead projector

OBSERVATIONS: - SAMPLE

Layout: Desk group arranged around the room facing no particular direction spaced apart for access

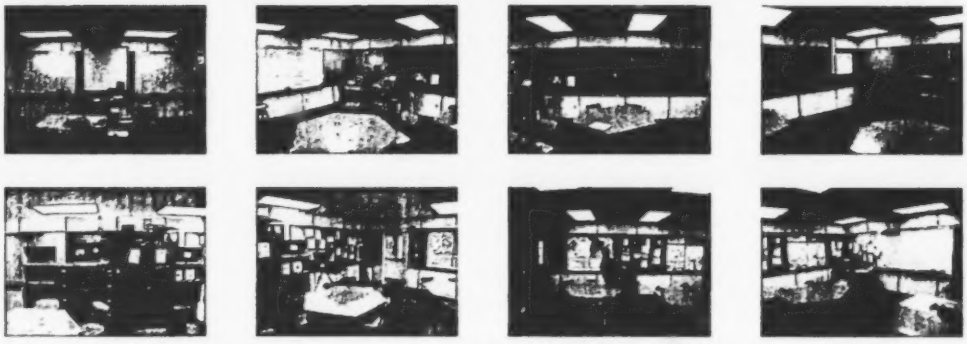
Light/glare: Sunny afternoon but sun past east side of building, blinds open and security screen evident, room still appears somewhat dim but adequate overhead illumination, lights bouncing off during OH demonstration

Noise: Teacher's voice, some student comments, fan very noticeable and unit ventilator always on (constant hum) but pretty quiet, announcements over the intercom speaker

Temperature: Windows open but pleasant

Teacher used overhead projector to demonstrate ideas with lights out; student movement caused vibration through the floor to the OH projector (vibrated down), one group pounded on table – distracting some others, there was a constant heat pump noise; during desk assignment teacher moved around freely answering questions with student interactions.

Photographs:



FOLLOW UP QUESTIONS

Teacher Responses Interview

1. **(I)** Please explain how you organize your classroom for specific instruction for different kinds activities in your present classroom environment ... **(II)** Explain what works or if anything bugs you about the room when you are doing this... (i.e. not enough light, too much light for certain activities, too noisy, too small, too warm/cold, etc.)
2. Have you changed the way you now set up your classroom from the way you did it in the classroom you were in last year? List some of the differences if any...
3. What would you change about the room to have a more effective teaching/learning environment?
4. What is the most critical physical characteristic of your room that is either beneficial or detrimental to your teaching style? Why?
5. Has there been an instance in the past that required you to either alter your routine or change the room characteristics (block up windows, raise your voice, bring in lights)?
6. Does the way you teach or the subject matter you teach require any special physical needs within the room?
7. When I observed your teaching, I noticed that you... were you aware of this?
8. Do you anticipate any changes in the way you teach when you move into the new school classrooms in another year?
9. Aside from formal instruction, how do you feel about the social environment of this school? Does the layout of this school allow the kind of interactions that you feel are necessary to perform your work either with your fellow teachers or with your students (i.e. places to meet, enough privacy or quiet spaces, access to materials, etc.)?
10. What kind of school environments that you have either visited worked in or wished for... would inspire you in your teaching? In other words name some of the ideal physical qualities that would cause you to "jump out of bed" in the morning just so you could come to work?
11. Final response: Given all the discussion about classroom environments, please describe the worst possible classroom environment that you can imagine that would discourage you from teaching and students from learning:

APPENDIX C

Data Results

Teacher Response to the Physical Environment
Data Results

QUESTIONNAIRE RESPONSES

ROOM TYPE	Teacher	QUESTION NO. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	G
P	1	E	E	C	D	E	B	D	E	E	D	D	E	A	E	D	A	E	E	E	E	A	N	N	N	N	N	B	A	B	C	C	D	N	N	E	F
US	2	B	A	A	B	D	B	A	D	C	B	B	D	A	A	B	B	D	C	A	A	A	N	N	N	N	N	B	B	B	C	C	C	N	N	A	M
P	3	D	D	B	C	D	B	C	C	C	D	D	D	A	B	A	A	E	B	B	A	A	N	N	N	N	N	C	A	B	D	N	N	N	B	N	M
RS	4	D	B	B	E	D	B	D	E	D	B	D	B	B	E	E	A	E	D	B	B	N	N	N	D	N	N	E	B	C	D	C	D	D	N	N	M
P	5	B	C	B	B	D	B	E	D	D	E	B	E	B	C	C	A	B	B	B	A	A	N	N	N	N	N	A	A	A	C	C	D	N	A	N	F
LN	6																																				M
RS	7	C	C	B	D	D	A	D	E	E	C	C	B	A	D	E	A	B	E	B	E	A	N	N	N	N	N	A	A	A	A	C	D	B	D	N	M
LN	8																																				M
LS	9	D	C	B	E	E	A	B	B	B	B	C	A	B	B	C	A	E	E	B	B	A	N	N	N	N	N	E	C	E	E	D	D	N	N	D	M
LS	10	E	D	B	D	B	B	B	C	A	A	A	A	B	D	D	B	E	E	E	E	N	N	N	D	N	N	A	A	A	D	C	B	B	N	N	F
LS	11	B	B	A	C	E	A	C	E	B	A	A	A	B	E	E	B	D	D	C	C	N	N	N	N	E	N	D	A	A	D	D	D	N	N	C	M
LS	12	B	C	C	D	B	A	D	D	D	C	C	D	A	D	D	A	D	D	D	D	N	N	N	N	N	F	D	A	B	E	E	E	B	N	N	M
RN	13	D	B	B	E	C	A	D	D	D	B	C	A	B	B	C	A	D	D	C	C	N	B	N	N	N	N	B	A	A	C	D	C	E	N	N	F
RN	14	E	E	C	E	B	A	D	D	D	E	D	A	B	B	D	A	B	C	D	D	N	B	N	N	N	N	A	A	A	A	C	D	D	E	N	F
LN	15	D	B	B	C	D	B	D	E	D	D	D	D	A	A	A	B	D	C	D	D	A	N	N	N	N	N	C	C	C	C	D	D	N	E	N	M
US	16	E	E	C	A	C	B	E	E	A	A	A	A	B	A	A	A	A	C	A	E	N	N	N	D	N	N	B	A	B	C	C	C	N	C	N	F
LN	17	E	E	C	D	D	A	E	D	C	E	E	B	A	B	C	A	D	B	B	B	A	N	N	N	N	N	A	A	A	D	D	D	N	B	N	F
RS	18																																				F
RN	19																																				F
LN	20	D	D	C	D	E	A	D	D	D	B	D	B	B	B	D	A	E	E	B	A	A	N	N	N	N	N	B	A	B	D	E	D	N	E	N	M
P	21	B	A	A	C	D	B	B	E	D	D	B	D	B	C	C	A	D	D	A	C	A	N	N	N	N	N	C	B	C	E	D	D	N	B	N	F
LN	22	E	D	C	D	D	B	D	D	D	D	C	D	A	D	B	A	B	A	C	B	A	N	N	N	N	N	E	C	E	E	D	D	N	E	N	F
LS	23																																				M
P	24	A	A	C	C	E	B	E	D	D	E	E	D	B	E	C	A	E	C	E	C	N	N	C	N	N	N	D	C	D	E	E	D	D	N	B	M
RN	25	E	E	C	E	E	B	C	D	D	E	E	C	A	D	D	A	E	E	D	D	N	B	N	N	N	N	C	B	C	C	C	E	N	N	F
RS	26	E	D	B	E	C	A	D	E	E	D	D	E	A	D	D	A	E	E	E	E	A	N	N	N	N	N	C	B	C	E	C	D	E	N	N	F
RN	27	D	D	B	D	B	B	B	C	B	D	D	E	B	C	C	A	D	D	E	D	N	N	N	N	F	A	A	A	B	C	C	E	N	N	M
US	28	B	A	A	E	E	Y	A	D	D	C	A	B	B	D	B	B	A	A	B	C	A	N	N	N	N	N	D	B	C	D	D	E	B	N	N	F
LS	29	A	A	A	D	A	B	A	D	B	D	C	A	B	A	A	B	A	A	A	A	A	N	N	N	N	N	C	B	C	E	D	D	C	N	N	F
RN	30	D	D	C	A	B	B	B	B	B	B	C	B	A	C	B	A	E	C	B	B	N	N	N	N	N	F	C	B	C	E	C	D	N	N	A	F
LN	31	D	D	C	B	D	B	D	D	D	C	D	C.	A	C	D	A	E	D	B	B	A	N	N	N	N	N	B	A	A	D	D	D	N	E	N	M

Class Room Type Legend
RS regular south facing
RN regular north facing
P portable (east facing)
LS lab or shop south facing
LN lab or shop north facing
US unusual south facing

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DEGREE OF MODIFICATION (from observations)

Teacher	least	minimal	moderate	high	very high	G	SHARED
1	N	N	N	N	4	F	
2	0	N	N	N	N	M	X
3	N	1	N	N	N	M	X
4	N	N	N	N	4	M	
5	0	N	N	N	N	F	X
6	N	N	2	N	N	M	
7	N	N	N	3	N	M	
8	0	N	N	N	N	M	X
9	N	N	2	N	N	M	X
10	N	N	N	N	4	F	
11	N	N	2	N	N	M	X
12	N	1	N	N	N	M	X
13	N	N	N	N	4	F	
14	N	N	N	N	N	F	
15	N	N	N	3	N	M	X
16	N	N	2	N	N	F	
17	0	N	N	N	N	F	X
18	N	N	2	N	N	F	
19	N	N	N	N	N	M	
20	0	N	N	N	N	F	X
21	N	N	2	N	N	F	
22	N	1	N	N	N	F	
23	0	N	N	N	N	M	X
24	N	1	N	N	N	M	
25	N	N	N	3	N	F	
26	N	N	N	N	4	F	
27	N	N	N	N	4	M	
28	N	1	N	N	N	F	
29	N	1	N	N	N	F	
30	N	N	N	N	4	F	
31	N	1	N	N	N	M	
	6	**7**	**6**	**3**	**7**	**28**	
	least	minimal	moderate	high	very high		
						SHARED	
	6	2	2	1	0	11	
M	3	3	3	2	1		
F	3	4	3	1	6		

CODING RESULTS OF FOLLOW UP QUESTIONS

A=PHYSICAL WELL BEING

1=SIZE 1a=area, b=height
2=ILLUMINATION 2a=light, b=glare, c=view, d=natural
3=NOISE 3a=outside, b=inside
4=TEMP/VENT 4a=temp, b=vent
5= FURN/FINISHES e=ceiling

B=BEHAVIORAL-PROJECT GOALS

1=SIZE 1a=area
2=ILLUMINATION 2a=light, c=view, d=natural
3=NOISE 3a=outside, b=inside
4=TEMP/VENT 4a=temp, b=vent
5= FURN/FINISHES 5a=student furn., b=teacher furn., c=floor, d=wall
6=TOOLS 6a=outlets, b=writing/tack board, c=(computer) equipment, d=misc tools
13=prep space

C=SYMBOLIC MEANING

1=SIZE b=height
5= FURN/FINISHES d=wall
7=classroom sharing
8=faculty interaction/gathering
9=student gathering area
10=central services
11=building character
12=building size
13=prep space
14=feeling-culture of place
15=no change
16=safety/security
17=time

Teacher Responses Interview - Follow-up Statements/Questions:

1. **(I)** Please explain how you organize your classroom for specific instruction for different kinds activities in your present classroom environment … **(II)** Explain what works or if anything bugs you about the room when you are doing this… (i.e. not enough light, too much light for certain activities, too noisy, too small, too warm/cold, etc.)

   (I) **(A)**

   (B) (1. 1a/5a) (2. 1a/5a) (3. 1a/5a) (4. 1a/5a/6c) (5. 1a/5a) (6. 1ab) (7. 1a/5a/6c) (8.1a/6c) (9. 1a/5a) (10. 1a/5a/6c) (11. 1a/5a/6c) (12. 1a/5a/6c) (13. 1a/5a) (14. 1a/5b) (15. 1a/5a) (16. 1a/6c) (17. 1a/5a) (18. 1a/6cd) (20. 1a/6c) (21. 1a/5a/6c) (22. 1a/5a) (23. 1a/5a/6c) (24. 1a/5a) (25. 1a/5a) (26. 1a/5a) (27. 1a/5d) (28. 1a/5a) (29. 1a/5a/2a) (30. 1a/2a/5ad) (31. 1a/5a)

   (C) (19. 5abd)

   (II) **(A)** (3. 1b) (5. 1a)(6. 3b) (8. 3b/4ab) (11. 4ab) (14. 1a) (15. 1a) (17. 5b) (20. 1a) (21. 1a) (28. 1a/3b/4ab) (29. 4a)

   (B) (1. 2b/3b) (2. 3b /4ab/6b) (3. 6bc) (4. 2a) (5. 5ab/2a) (6. 2a/1a) (7. 6c) (8. 6cd) (9. 1a) (10. 1a/5a) (11. 1a) (12. 1a) (13. 1a/5a) (15. 1a/5a) (18. 1a/6cd) (20. 1a/5bc) (21. 1a/6b) (22. 2a) (23. 1a/5a/6c) (24. 4a/5c/6ac) (25. 1a/5a) (26. 1a) (27. 1a/2b/4a) (29. 1a/5ab/4a/6a) (30. 5a) (31. 6abd)

   (C) (19. 5d)

2. Have you changed the way you now set up your classroom from the way you did it in the classroom you were in last year? List some of the differences if any…

   (A) (3. 1b "lower ceiling")(11. 4b) (13. 1b) (27. 14 "better feel") (31. 8 "isolated")

   (B) (1. same) (2. 1a/5a) (3. same/5c) (4. same/5a) (5. 1a/5a) (6. 1a/5a/6c) (7. same) (8. 1a/6c) (9. 1a/3b/5a) (10. 1a/5a) (11. 6c) (12. 1a/5a) (13. same/1a/5a/6b) (14. same/5b/6ab) (15. 1a/5a) (16. 1a) (17. same) (18. 1a) (19. 1a) (20. same/1a) (21. 1a/6c) (22. 5b/6ac) (23. 1a/5a/6c) (24. 5b) (25. same) (26. same/5bd) (27. 1a) (28. 1a/5ac) (29. 1a/5ab/6a) (30. 1a/5ab)(31. 3b/4ab/5e)

   (C) (19. 14 "old had more character")

3. What would you change about the room to have a more effective teaching/learning environment?

   (A) (1. 2c) (3. 1b) (4. 3a/4a) (10. 2b/3a/4a) (11. 4a/"music") (21. 14 "water") (23. 4a) (27. 2b) (29. 1b) (30. 2c/3a "hate announcements, disruptive, intrusive")

   (B) (1. 2a/5b/6a) (2. 1a/6ab) (4. 2a) (5. 5a/6b) (6. 5a/6c) (7. 5a) (8. 1a/6d) (10. 5a) (11. 1a) (12. 1a/5a) (13. 1a/5b) (14. 5a) (15. 1a/2a/6ad) (16. 5b/6b) (17. 1a/5bd) (18. 1a/5b) (20. 5a/6ac) (21. 1a/2a/4b/5c6abd) (22. 2a/6acd) (23. 1a/5a/6c) (24. 2a/5b/6c) (25. 5a/6c) (26. 1a/5a) (27. 6c) (28. 1a/5b/6abc) (29. 1a) (30. 2a/6b) (31. 5a/6a)

   (C) (5. 5d "personalize") (19. 14 "not inviting") (20. 14 "not inspiring") (25. 14 "more comfortable") (27. 5d "different paint")

4. What is the most critical physical characteristic of your room that is either beneficial or detrimental to your teaching style? Why?

   (A) (2. 4a/3a) (3. 1b) (5. 1a "crowded") (6. 3b/5e "don't like guts out look") (9. 3a/4a "really hot") (10. 4a) (11. 4ab) (12. 4a "creature comforts") (20. 2d "natural light") (25. 2d "natural light, good feeling") (26. 5c "hardwood floors, don't like carpet) (28. 1a/4b "stagnation = colds") (30. 7 "personalize space")

   (B) (1. 1a) (2. 6b) (4. 1a/5a) (6. 1a) (7. 6d) (8. 1a) (9. 13 "no prep") (10. 1a/5a) (11. 1a) (12. 1a) (13. 1a) (14. 6a) (15. 1a/5a) (16. 1a) (17. 1a) (18. 5b) (19. 6b) (20. 6d) (21. 1a) (22. 1a/2a/5b) (23. 1a/5a) (24. 4a/6b) (26. 5d "aesthetically coordinated [w/lesson plans]") (27. 1a) (29. 1a) (30. 6bc) (31. 1a)

   (C) (19. 14 "focal point, sense of place") (24. 5d "neutral colors") (26. 14 "pride in place")

5. Has there been an instance in the past that required you to either alter your routine or change the room characteristics (block up windows, raise your voice, bring in lights)?

   (A)

   (B) (1. 2ab) (2. 6b) (3. 4ab) (4. 2a) (5. 5a) (6. 1a/6c) (7. 4a) (8. 5a) (9. 2ab/3ab) (10. 3b) (13. 1a/5a/2b/6a) (14. 5a/6abc) (15. 1a/2a/3b/4a) (16. 3b/5a) (17. 5c) (18. 6d/17) (19. 5ad) (20. 5a/6d) (21. 6ac) (22. 1a/5a) (23. 5a) (24. 1a/6c) (25. 1a/6c) (26. 1a/5a) (27. 5a) (28. 15) (29. 2a/5b/6d) (30. 5ad) (31. 2ab/6d)

   (C) (11. 16) (12. 16) (19. 14)

6. Does the way you teach or the subject matter you teach require any special physical needs within the room?

   (A)

   (B) (1. 2ab/5c/6bc) (2. 6c) (3. 1a/6d) (4. 5a/6c) (5. 5a/6c) (6. 1a/6c) (7. 1a/5b) (8. 1a) (9. 1a/5a) (10. 6bc) (1a/5a) (12. 6c) (13. 6c) (14. 1a/6a) (15. 6cd) (16. 5c/6d) (17. 6cd/16) (18. 5a/cd) (19. 3b/5ab) (20. 5b) (21. 1a/6ac) (22. 6acd) (23. 5a/6c) (24. 1a/5a/6d) (25. 1a) (26. 1a/2ac/6d) (27. 3b/6c) (28. 1a) (29. 1a/6a/16) (31. 1a/2a/6acd)

   (C) (19. 14)

7. When I observed your teaching, I noticed that you… were you aware of this?

   (A)

   (B) (1. 3b/4a) (2. 3b) (3. 3b) (4. 3b) (5. 3b) (6. 1a) (7. 2a) (8. 3b) (9. 3b) (10. 3b) (11. 2a) (12. 2a) (13. 3ab) (14. 3b) (15. 3b) (16. 3b/4ab) (17. 3b) (18. 1a) (20. 3a) (21. 1a/3b) (22. 6c) (23. 5a) (24. 1a) (25. 3b) (26. 6c) (27. 3b) (29. 3b) (30. 1a/6cd) (31. 3b)

   (C)

8. Do you anticipate any changes in the way you teach when you move into the new school classrooms in another year?

   (A)

   (B) (2. 6c) (5. 5a) (7. 6c) (8. 1a) (10. 5a/6c) (11. 1a/5a) (6cd) (21. 1a) (22. 1a) (23. 15) (24. 3b) (25. 5a) (26. 6c) (28. 1a/3a/4ab) (29. 12) (30. 1a) (31. 6c)

   (C) (1. 7 Identity-sharing) (2. 7 Personalization) (3. 7 Safeway cart) (5. 7 Stinks!) (6. 15) (9. 7/13) (10. 7) (12. 7) (13. 7) (14. 15) (15. 7/13/14) (16. 15) (17. 7) (18. 7) (19. 7) (20. 7) (21. 7) (24. 7) (25. 7) (26. 7/14) (27. 7 Sucks!) (28. 7/17) (29. 7) (30. 7/13)

9. Aside from formal instruction, how do you feel about the social environment of this school? Does the layout of this school allow the kind of interactions that you feel are necessary to perform your work either with your fellow teachers or with your students? (i.e. places to meet, enough privacy or quiet spaces, access to materials, etc.)

(A)

(B)

(C) (1. 8/9) (2. 12) (3. 12) (4. 8/12) (5. 8/12) (6. 9/12) (7. 8) (8. 10/12) (9. 8/12) (10. 10) (11. 8/12/14) (12. 8/12) (13. 8/12) (14. 12) (15. 8/10/12) (16. 8/9/12) (17. 8/12) (18. 8/12) (19. 9/10/12/14) (20. 8/10/12) (21. 8/12) (22. 8/10/12) (23. 8/12/14) (24. 8/9/10/12) (25. 8/9/12) (26. 8/10/12) (27. 11) (28. 8/12) (29. 8/10/12) (30. 8/9/10/11/12) (31. 8/9/14)

10. What kind of school environments that you have either visited worked in or wished for... would inspire you in your teaching? In other words name some of the ideal physical qualities that would cause you to "jump out of bed" in the morning just so you could come to work?

(A) (8. 2d) (13. 4a) (16. 2d) (17. 2d) (21. 2d) (28. 2d)

(B) (1. 1a/2a/6c) (2. 6c/8/9/13) (4. 6c) (5. 1a/5a/6c) (6. 1a/6c) (2c/5a/6bc) (10. 6b) (13. 1a/5a) (14. 1a/6c) (15 1a/2a/4a) (16. 1a) (17. 6d/12) (18. 1a/2ac/6d) (20. 1a) (21. 1a/6bc) (22. 1a/2a/6a/17) (23. 1a/3b) (24. 2ac/4ab/5ac/6bc) (25. 2ac/5c) (27. 1a/6c) (28. 5c) (29. 1a/5c) (30. 2c/4ab/6cd) (31. 1a/2c)

(C) (1. 11) (3. 11) (4. 12/14) (5. 14) (8.11/14) (11. 14) (12. 11/14) (14. 1b/7) (16. 16) (19. 14) (20. 14) (23. 8/9) (25. 1b) (26. 7/14) (28. 1b/11) (30. 5d/14) (31. 11)

11. Final question: Given all the discussion about classroom environments, please describe the worst possible classroom environment that you can imagine that would discourage you from teaching and students from learning:

(A) (1. 2b) (21. 1b) (28. 2d no natural light)

(B) (1. 2a/5a/6bc) (2. 7) (3. 5a/6bd) (4. 1a/2a/3b) (5. 1a/5a/4a) (6. 2a/3b/4b) (7. 1a/2a/4a/5d/6b) (8. 1a/6c) (9. 1a/2a) (11. 4a) (12. 1a/2a) (13. 1a/2ac/4a/6abc) (14. 1a/2a/3ab/4a) (16. 1a/2c) (17. 1a/2a/4a) (18. 1a/2ac/4b/6acd) (19. 1a/6c) (20. 6c) (21. 1a/2a/5ad/16) (22. 1a/3b/6ad) (24. 1a/2c/5a) (25. 1a/2ac/5c) (26. 1a/3b) (27. 1a/3a) (28. 1a/4ab/5c) (29. 1a/5ab) (30. 1a/3b/4a) (31. 1a/4a)

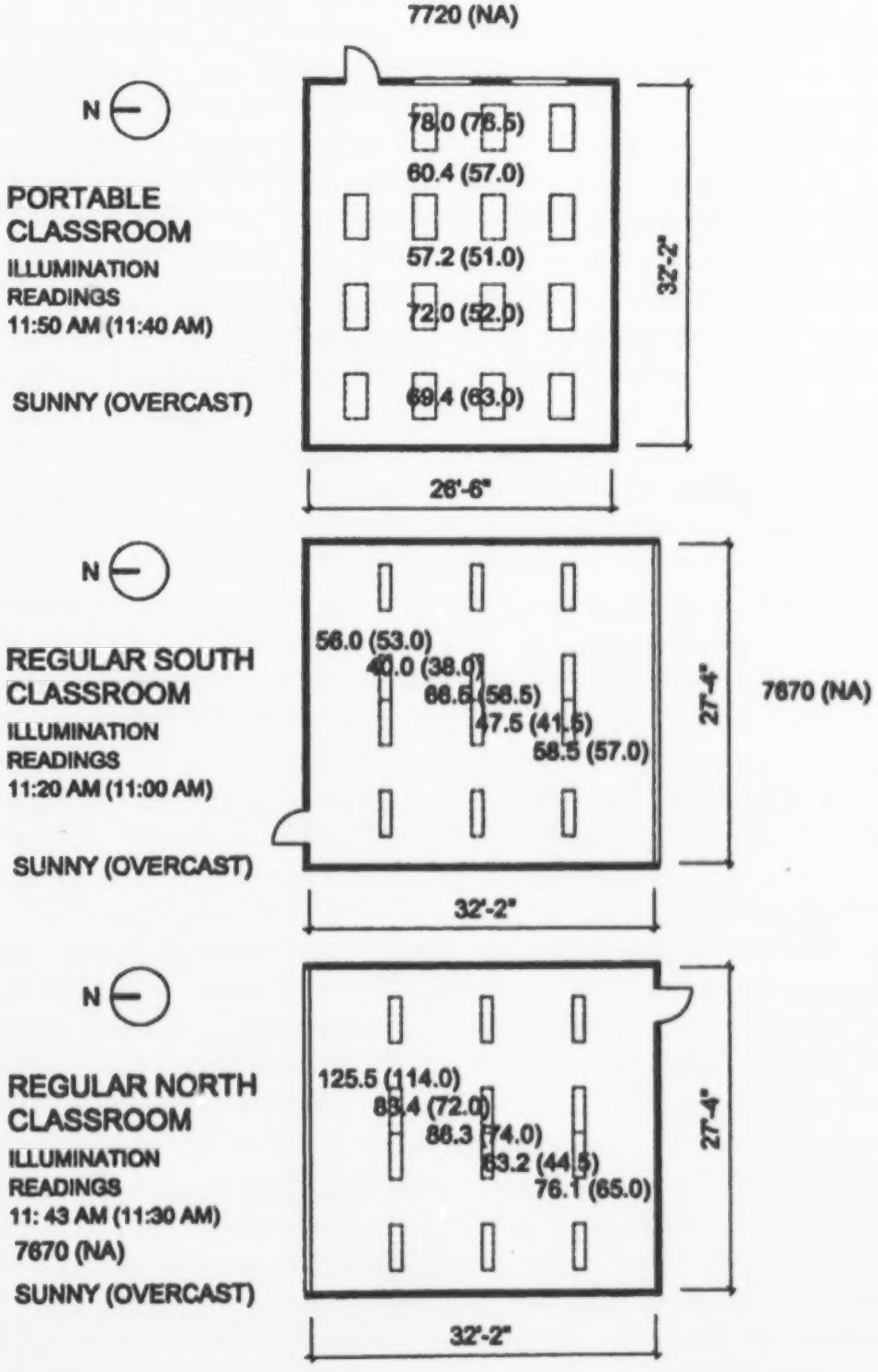
(C) (5. 7) (8. 14) (9. 14) (10. 14) (11. 7) (12. 9/11/14) (15. 7/15/17) (16. 12) (17. 7) (19. 7/14) (20. 7/14) (22. 7) (23. 7/11/14) (24. 14) (25. 14) (27. 14) (31. 10/11)

Interview Results - Teacher Responses

Answers			Question Number 1a	1b	2	3	4	5	6	8	9	10	11	sum	
A	1	a		5			2							7	
	1	b		1	2	2	1							6	
	2	a												0	
	2	b	2	2		2		4	1					11	
	2	c				2						6		8	WELL BEING
	2	d					2					7		9	
	3	a				3	2							5	
	3	b					1							1	
	4	a				4	4					1		9	
	4	b			1		2							3	
	5	e			1									1	
B	1	a	29		18	13	17	6	14	6		15	22	140	
	2	a		3		7	1	6	3			4	12	36	(sometimes) control
	3	a						1		1			1	3	
	3	b		3				4	2	1		1	6	17	
	4	a		4			1	3		1		2	9	20	PROJECT GOALS
	4	b		1				1		1		2	3	8	
	5	a	25	7	13	11	4	11	8	4		4	5	92	
	5	b	2	3	5	7	2	1	2				1	23	
	5	c			1	1		1	2			3	2	10	
	5	d	2		2	1	1	2					1	9	
	6	a		2	3	8	1	3	5			1	3	26	
	6	b		3	2	6	4	1	2			3	3	24	
	6	c	11	6	6	8	1	5	16	6		10	6	75	
	6	d		2		4	2	4	9	1		3	3	28	
	13						1			3				4	
C	1	b										3		3	
	5	d				2	1					1		4	
	7									21		1	7	29	
	8				1						22			23	
	9										7			7	
	10										10		1	11	
	11										2	7	4	13	SYMBOLIC
	12										25	1	1	27	
	13													0	
	14				1	3	2	1	1	2	3	9	10	32	
	15				10					3			1	14	
	16							2				1		3	
	17									1			1	2	

APPENDIX D

Physical Classroom Measurements



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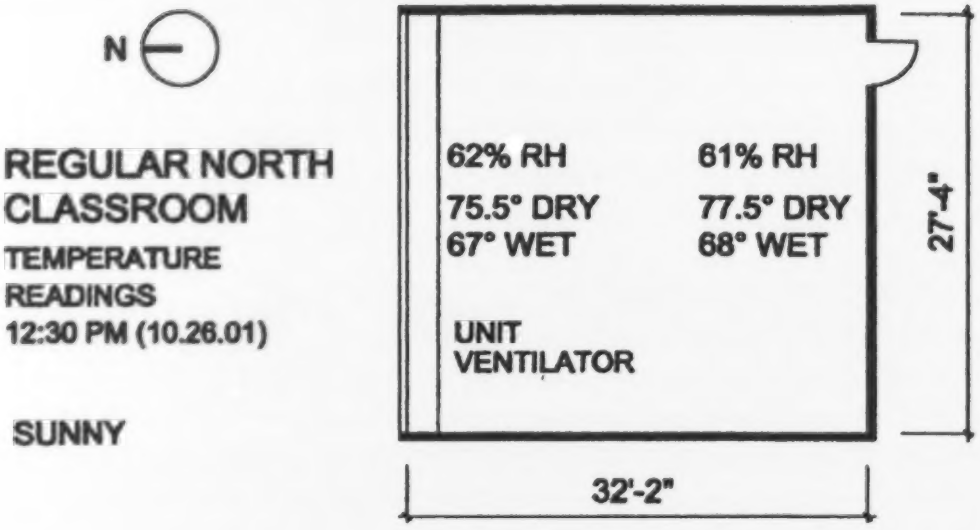
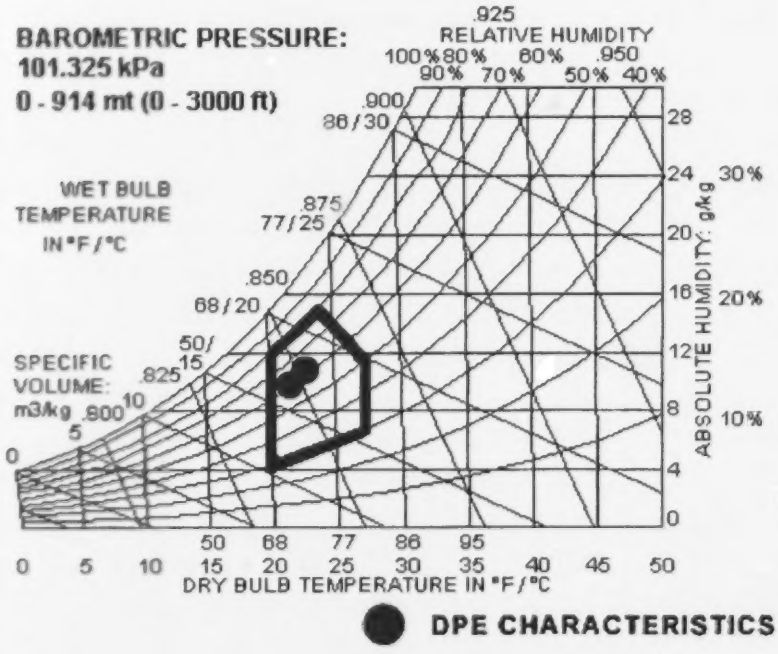


Comfort Zone in Psychrometric Chart



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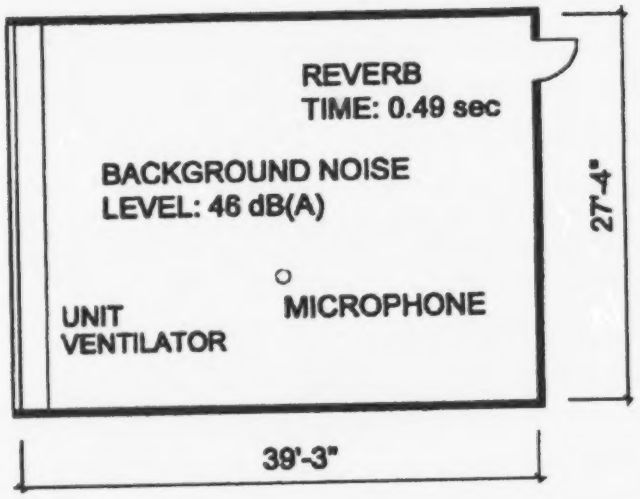
N

REGULAR NORTH CLASSROOM
ACOUSTICAL READINGS

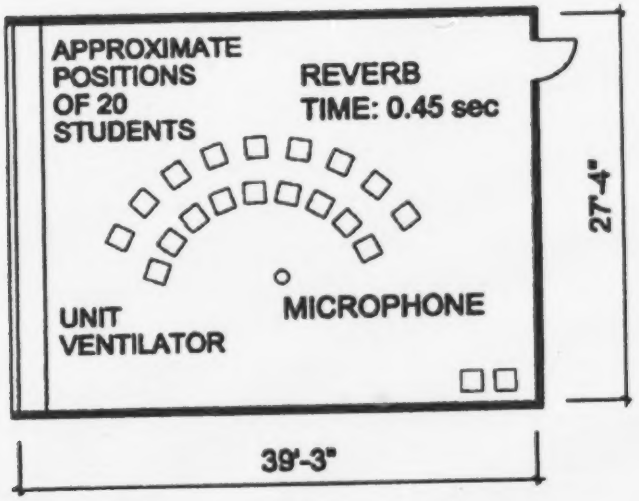
UNOCCUPIED

12:30 PM (10.26.01)



OCCUPIED
(20 STUDENTS)

1:10 PM (10.26.01)



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VITA

Name:	Dale Christopher Lang
Permanent Address:	909 N 35th Street, No. 201 Seattle, WA 98103
Degree and Date to be conferred:	Ph.D. 2002
Secondary Education:	La Habra High School, 1966
Colleges Attended:	
Cypress Community College	1966 - 1967
California Polytechnic State University	1967 - 1972 B. of Architecture, 1972
University of Washington, Seattle	1994 - 1996 M. of Architecture, 1996
Majors:	Architecture & Education
Honors:	Scarab Honor Society
	National Endowment for the Arts & Masonry Institute Honor Award
	AIA Merit Award, Inland Valley Chapter
Positions Held:	1972 - 1975 Designer, Daniel, Mann, Johnson & Mendenhall, Los Angeles
	1975 - 1978 Architect, Barmakian Wolff & Associates, Rancho Cucamonga, CA
	1978 - 1994 Principal Architect, Wolff Lang, Christopher, Rancho Cucamonga
	1994 - 1996 PM/Architect, Meng & Associates, Seattle (while at UW)
	1997 (Summer) Architect, NBBJ, Seattle (Graduate Student, College of Education)
	1997 - 2002 Architect/Doctoral Candidate Bassetti Architects/UW, Seattle
Professional Architectural Licenses	States of Washington & California, NCARB Certified
Publications	"Reconnecting Community and School: Initiatives to Expand Children's Environments" co-authored with Julie Johnson, UW Assistant Professor Department of Landscape Architecture

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